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Official Notices.

CROSS AND BEVAN ESSAY PRIZE OF £20 AND LATHAM RESEARCH GRANT OF £300.

The Council have pleasure in announcing that a gift of £20 has been made by Messrs. Cross and Bevan as a prize for an essay on "The Interconnection of Economic Botany and Chemical Industry."

A further sum of £300 has also been presented by their friend, Mr. T. P. Latham, of Weybridge, to be paid in three annual instalments to such one of the competing essayists as may be judged to be of conspicuous ability, as a grant towards his expenses, on the condition that he apply himself, during three years, to research of approved character on a subject cognate with that discussed in his essay.

The immediate object of the donors is to promote the study of economic botany with special reference to its bearing on chemical industry, giving the widest possible interpretation of the relationship.

They desire, under the auspices of the Society, to assist in forming public opinion in this direction and to discover and further the career of a student of promise who may wish to devote himself to work in such a field.

The Essay Prize will be open to all members of the Society who are British subjects. The Research Grant will be limited to competitors under 25 years of age at the time of sending in the essay.

Essays are to be submitted to the Council of the Society not later than the close of the year 1917. The awards will be made promptly. Neither the prize nor the first grant will be given unless the essayist or essayists shall be deemed to have real merit. The Latham Research Student will be required to submit a report at the close of each year, to satisfy the Council that he has made and is likely to make proper use of the grant.

REPORTS ON THE PROGRESS OF APPLIED CHEMISTRY.

The first volume of the Reports of the Progress of Applied Chemistry is now in active preparation, and will, it is hoped, be published shortly. It will cover recent progress to the end of June, 1916. The second volume will deal with the period up to the end of 1917, and subsequently it is proposed to issue the Reports annually.

The Reports will present a critical summary of the progress that has been made in the various branches of chemical industry during the period in question. It has not been found practicable to treat every section of the Journal classification. Agricultural chemistry, the chemistry of foods, and analysis are fully dealt with in the admirable series of Reports issued annually by the Chemical Society, and for the present there will be no sections on general plant and explosives.

The following is a list of the subjects which will be dealt with, together with the names of the experts who are contributing to this volume:—

Fuel—J. W. Cobb.

Gas, destructive distillation, tar products—E. V. Evans.

Mineral oils—A. W. Eastlake.

Colouring matters and dyes—G. T. Morgan.

Fibres, paper, dyeing, printing—Julius Huebner.

Acids, alkalis, salts, etc.—H. A. Auden.

Glass, ceramics, cement, etc.—J. A. Audley.

Metals, metallurgy—W. R. E. Hodgkinson.

Electro-chemistry—J. T. Barker.

Fats, oils, waxes—G. H. Warburton.

Paints, pigments, varnishes, resins—R. Morrell.

Indiarubber—H. P. Stevens.

Leather, glue, etc.—J. T. Wood.

Sugar, starches—J. G. Macintosh.

Fermentation—A. R. Ling.

Sanitation, water purification—F. R. O'Shaughnessy

Fine chemicals, medicinal substances, essential oils—F. L. Pyman.

Photographic materials and processes—B. V. Storr.

The price of issue will be, to members, 2s. 6d. (plus 6d. postage), and non-members, 5s. (plus 6d. postage). As the issue is to be a limited one, those desirous of securing copies are requested to fill in the order form attached to the cover of the Journal, and return it to the Secretary at an early date.

Editorial.

THE CHEMIST AND THE ENGINEER.

The relationship between the chemist and the engineer in our chemical industries has for a long time been a subject of much discussion. Our President, in his address to the London Section (see this J., 1916, 1185), has expressed it as his conviction that "the engineer should be taught sufficient chemistry to be able to appreciate the chemist's point of view, and the chemist should know enough of engineering to realise that with the engineer thus trained he can leave the practical application of the processes he devises in the laboratory and supervises in the chemical works." It is generally agreed that cordial co-operation between the chemist and the engineer, each having some knowledge of and sympathy with the sister science, forms the best basis on which to found a successful chemical industry. In the discussion which followed this address the claims of the "chemical engineer" were put forward by several speakers—but what is a chemical engineer? Is he more than the engineer who knows sufficient chemistry to appreciate the chemist's point of view? It has been advocated in some quarters that the ideal chemical engineer would be one who had been thoroughly trained both in chemistry and in engineering; but, as has been frequently pointed out, the student has not the time nor the means to devote to this extended training, and even supposing he had, there are very few who possess the type of mind which is capable of acquiring a thorough grasp of the two sciences. Such a training would, in all probability,

result in our industries being provided with a few men who had the makings of the best type of chemical engineer, and a large number of men insufficiently grounded in either of the subjects—a type which must be avoided at all costs.

The only possible form of training for the man destined to be come a chemical engineer would seem to be thorough instruction in engineering, together with sufficient grounding in chemistry to bring him into sympathy with the problems which will face him in the chemical works. We must look to our engineering colleges to produce this type of man in the numbers which present-day chemical industry demands—numbers which must increase largely in the near future if the hoped-for development of these industries is to take place. A man trained on these lines will be fitted to pass to the works where he will receive his real training in the science of chemical engineering—the experience which can only come from daily contact in the works with the innumerable problems which arise in the translation of chemical reactions from the laboratory to the factory, and in the solution of these problems it is essential that he should collaborate with the chemist, who has devised the process or is controlling its progress.

Reverting to the question of the relations between the chemist and the engineer, it is interesting to note that in an address to the Derby Society of Engineers on November 20th, Mr. L. Archbutt instanced metallurgical operations and processes involving destructive distillation as those which the chemist was best fitted to take charge of. Surely these are just the processes in which co-operation between the chemist and the engineer is most needed, for the engineering problems involved are just as great as the chemical problems. The danger of leaving the control of such processes in the hands of either the chemist or the engineer has been clearly brought out on more than one occasion and is so obvious as to require no further emphasis here. In some industries the work of the chemist may be of more importance than that of the engineer, whilst in others the chemical problems are of a subordinate nature, but it must now be recognised as an established fact that there is no branch of chemical industry in which collaboration and co-operation between the chemist and the engineer is not necessary.

AN APPEAL TO MEMBERS.

The extraordinary conditions which have prevailed during the last two years have resulted in the awakening of an increased interest in and appreciation for the value of science, and particularly of chemistry, in the industrial life of the nation. The public generally is beginning to realise that chemical industry, in its broadest sense, is not confined to a few evil-smelling factories, but that it is the life-blood of our very existence. The work of the Society of Chemical Industry and the value of its Journal have been brought to the notice of many who, in former days, were unaware even that such a Society existed; there are still very many, however, who have no knowledge of its labours, but who would undoubtedly derive value from membership of the Society if its advantages were put before them. The Society, too, needs the support of all those interested in chemistry as applied to arts and manufactures. Every member is therefore requested to use his endeavours to persuade all those whom membership can benefit, to join the Society, and the Secretary will be glad to send application forms to any member, or to any prospective member, when requested to do so.

Liverpool Section.

Meeting held on Friday, November 3rd, 1916.

MR. JOHN GRAY IN THE CHAIR.

THE USE OF PEAT IN GAS-PRODUCING PLANTS.

BY E. C. C. BALY.

The problem of the economic utilisation of peat has many times been discussed in this country, but as far as one is able to judge from results little or no advance has been made beyond the somewhat obvious notion of utilising peat in some way as a fuel. In general all attempts on such lines may be said at the outset entirely to have failed, and indeed considerable sums of money have been lost in fruitless endeavours to find a satisfactory solution on those lines. The essential difficulty of the utilisation of peat is to be found in its enormous bulk in relation to its thermal efficiency. Add to that the very high water content of freshly cut peat and the trouble and peculiar difficulties involved in the effective drying of the torves, and then I feel that the failures which have been reported are such as any modern man of science would fully have expected. As a result of these failures and moreover of the adverse reports of various important committees of investigation the reputation of peat bogs is under a serious cloud, and there are few men who would consider themselves blessed by fortune were they given the freehold of a very large tract of the very best bog.

In spite of all that has been said the problem is a fascinating one. Every one is fully aware of the vast tracts of peat bog in these islands, and the successful utilisation of the hundreds of millions of tons of peat very obviously would add most considerably to the economic resources of the country.

I may say categorically that the problem has been solved and the object of this paper is to illustrate how it has been solved. In brief the solution lies in the utilisation of the peat in gas-producer plant, and its success lies in the fact that all difficulties involved in the drying of the torves are eliminated.

Before dealing with large peat producer plants in which further economy is obtained by the recovery and utilisation of by-products, I will briefly describe the plant at Messrs. Hamilton Robb's works at Portadown in Ireland, which has been in use for five years. This plant is as simple as possible in design and no effort is made to recover any of the by-products. Inasmuch as it is found to be economical under these conditions it is worth a few words of description. It is a suction plant, that is to say the air is drawn through the producers by means of a fan.

There are two producers, each with a capacity of 200 h.-p., and there are two Crossley gas engines of 120 h.-p. and one of 150 h.-p. The gas drawn from the producer before being used must be freed from tar and dust. This is effected by passing it through scrubbers down which copious streams of water are passed. These wash waters from the scrubbers pass through a labyrinth where the insoluble tar collects and is removed. All the soluble products are however lost. There is a small gasometer installed in order to minimise the periodic action of the gas engines. At present nothing is done with the tar.

The peat is obtained from a bog about 12 miles away where it is air-dried. The torves are brought

down by barge and after being elevated by a simple device are fed direct into the top of the producers.

For the working cost of the plant I am indebted to a paper by G. Fletcher (Journ. Department of Agriculture, Ireland, 1915, 16, 33). The figures given are as follows:—

Cost of running per week on coal.

	£	s.	d.
8·5 tons anthracite at 35s.	14	17	6
19 tons steam coal at 17s.	16	3	0
	31	0	6

Cost of running per week on peat.

	£	s.	d.
50 tons peat at 6s.	15	0	0
Extra labour		15	0
Saving	15	5	6
	31	0	6

These figures however were obtained in 1912.

In view of the fact that all the valuable by-products are not utilised it must be confessed that the above return of cost is eminently satisfactory.

Now the by-products from peat producer gas are peculiarly valuable, especially when Irish peat is used, owing to the relatively high percentage of nitrogen in the peat. As is well known the institution of the recovery of the nitrogen as ammonia from coal gasified in producers is due to Ludwig Mond, who substituted for the simple suction plant producers fed with a blast of steam and air, the mixture of steam and air being previously heated. This naturally modifies the composition of the producer gas obtained owing to the fact that the reaction temperature is lower from the presence of the steam. This results in a greater predominance of the reaction $C+2H_2O = CO_2+2H_2$ over the reaction $C+H_2O=CO+H_2$. An average sample of the gas from a coal is CO 11%, H_2 24%, CH_4 3%, CO_2 17%, N 45%. It is possible in a Mond plant with a ton of coal containing 1·2—1·6% of nitrogen to obtain over 100 lb. of ammonium sulphate and 150,000 cb. ft. of gas with a calorific value of 150 B.T.U. per cub. ft.

Now, in the Mond gas plant when coal is used the producer is fed with a blast of air saturated with steam at 85°, which has previously been heated to a temperature of 250°. This method requires some slight modification when peat containing moisture is used, but this modification is simple enough. The problem has been investigated by Frank and Caro, and by others, and the broad results of their work may be found in various papers in the Zeitschrift für angewandte Chemie, and other journals (Z. angew. Chem., 1907, **20**, 1592; 1910, **23**, 1844; Chem.-Zeit., 1911, 35, 207, 505, 515). The literature on the subject is however somewhat clouded, partly by there having been a long controversy as to whether any ammonia is formed synthetically when moist nitrogen is passed over glowing peat, and also by a very highly suggestive reticence on the part of the authors as to actual details. It is however quite clear that peat producer plants have been working and are still being worked in Germany and elsewhere with extraordinary success.

It is obvious I think that for successful economic work it is necessary that the plant be fed with peat which has not been specially dried. The cost of introducing a drying process would be prohibitive owing to the great bulk of the peat to be handled. This however is entirely unnecessary since it has been proved conclusively that the ordinary air-drying such as is obtained by stacking the torves in the usual way is amply sufficient. It is perfectly possible to utilise peat containing as much as 70% of moisture in a Mond plant, and this is fundamentally important since it allows peat which has been air-dried in the winter months to be used without any further drying.

It has in fact been found that the nitrogen is recovered as ammonia more easily with a wet peat than with a dried peat. The process is however slower with a wet peat than with a dried peat. If a dried peat is fed into the producer the following processes take place. In the upper layers the peat is completely dried and this takes place rapidly enough. As the peat sinks in the producer it reaches the second or combustion zone where it is decomposed in presence of the steam and air with formation of ammonia, tar, etc. It then reaches the coking zone of much higher temperature, where the combustion is completed, leaving only the ash as a white powder. If on the other hand a wet peat is used the time taken in the drying process in the upper layers in the producer is longer, with the result that the zone of combustion is reduced in thickness. The peat passes too rapidly through this zone and does not give up all its nitrogen. It enters the coking zone and then forms a nitrogen-containing coke in which the nitrogen is fixed. Moreover in addition to a small yield of ammonia a poor quality of gas is obtained owing to the smallness of the second or combustion zone.

The difficulty is surmounted by increasing the temperature of the drying zone from 100—120° C. (which it shows normally) to 250° C. This in general is sufficient to set free the whole of the nitrogen as ammonia by the action of the steam on the peat. This temperature rise is obtained by preheating the air-steam blast to 450° C. instead of 250° as is sufficient in a coal-fed producer. This gives an intensive combustion of the coke, an increase in the size and temperature of the combustion zone, together with an almost quantitative recovery of the nitrogen as ammonia, an increase in the thermal efficiency of the gas and also a good quality of tar. The amount of steam used should not exceed half the weight of the peat gasified and its partial pressure should fall below 250 mm.

There is no need to enter into the details of the process of the removal of the dust, tar, and ammonia from the gas. These are more or less standardised and may be found in any work on producer gas manufacture, the processes being very similar whether coal or peat is being used. Attention may however be drawn to one point, namely, the use of a certain quantity of the gas produced in order to heat the preheaters used for the steam-air blast. This is not done in the case of coal-fed producers.

The following figures are typical of the results obtained by the above process with peat containing 50—60% of water. One ton of theoretically dried peat gives altogether from 88,000 to 92,000 cb. ft. of gas. Of this 39,000 cb. ft. is used in the preheaters, leaving 49,000 to 53,000 cb. ft. in excess. From this excess are developed 700—750 h.-p. hours. Further, from 70—85% of the nitrogen is obtained as ammonia and the yield of tar is from 3—6%.

As regards the cost the only published figure I have found, which was given at the inception of the process in 1907, is 1/17th of a penny per h.-p. hour (*loc. cit.*). At a later date (1911) Caro gives some figures which illustrate the size of one of the German works. In the Schweger bog works in December, 1911, the output of electrical energy was 430,000 kilowatt hours, which represents a plant capable of producing 6000 kilowatts. Each ton of theroetically dried peat in these works gave 1000 h.-p. hours and 90 lb. of ammonium sulphate. It is further stated that the cost of working was nothing as all expenses were paid out of the by-products. Peat containing up to 70% of water was used.

When one comes to consider the enormous deposits of peat in these islands I trust I have said sufficient to justify my statement that the time has now come entirely to revise our ideas as to the value of peat.

I have said nothing as regards the peat tar. There is no doubt that the Germans have been in the habit of distilling this tar and recovering valuable substances therefrom. Caro states that the tar from the Schweger works is distilled, and yields 15% of paraffin wax and 50% of neutral oils. This statement is characteristically vague, but fortunately we have the results obtained by G. T. Morgan in the distillation of tar from the plant at the Portadown works referred to above (Econom. Proc. Royal Dublin Society, 1915, 2, 161; see this J., 1916, 247). Briefly the results obtained by Morgan were as follows. The moist tar contains about 30% of water and yielded about 50% of volatile oils, and a residue of non-volatile bituminous pitch. The volatile oils consist of acidic oils, neutral oils, and waxes. The first are obtained by washing the volatile oils with sodium hydroxide and reprecipitation by the addition of mineral acid to the alkaline extract. The acidic oils consist of polyhydric phenols of very high germicidal power (Morgan and Scharff, Eng. Pat. 19,253, 1914; this J., 1915, 448). The neutral oils yield on distillation fractions boiling above 250° which deposit on cooling considerable quantities of an almost colourless wax, with a melting point of 35°—40° C.

In addition to the tar there are the soluble and volatile organic compounds which include methyl alcohol and acetic acid, as well as pyridine bases.

Finally there is the ash which varies considerably with the peat and lies between 5 and 15%. Analyses of various samples of peat ash have shown that they contain aluminium, calcium, magnesium, and iron as carbonate, sulphate, silicate, and phosphate. The alkali metals are also present, especially potassium. These facts at once suggest the use of the ash as a dressing for land. As Morgan points out this will partake of the restoration to the soil of those very mineral constituents absorbed therefrom by the peat vegetation.

Discussion.

The Chairman recalled the fact that van Grooven was the first to make known the production of ammonia from peat by the action of steam; the yield of ammonia from peat was very similar to that obtained in work with which he had been connected many years ago, namely, on Scotch shale. The cost of production of power from peat given by Professor Baly, 1/17th of a penny per horse-power hour, was attractively low. As regards the drying process, he knew that a good deal of money had been sunk in it, and he understood that in Scotland experimental plant had been erected and was working. He would like to know if it was likely to lead to success. The production of paraffin wax from peat had been tried some time ago but had come to nothing. The quantity of peat available in Great Britain was enormous, and if there was any possibility of getting supplies and working them in the manner that had been outlined those peat bogs would be of immense value to-day.

Mr. A. T. Smith said that it was very gratifying to know that a problem which had presented many difficulties was on the point of being solved. The great difficulty was to get the peat in such a condition that water would leave it. The ordinary method of air-drying was not satisfactory.

Dr. E. F. Armstrong said that if peat were used as fuel the extra cost of handling it would have to be met by using the by-products. He thought however the figures Professor Baly had given needed drastic criticism. The cost of the producing plant was four times as large as that of a Lancashire boiler, even if peat could be got at 6s. a ton from the bog to the works. He understood that the figures had been given to Professor Baly by others, but he could not help feeling that advocates of this sort did their cause a great deal of harm by putting forward doubtful figures.

Mr. Polack understood that a large plant had been erected in the neighbourhood of Dumfries, but that it had been closed down since the war. It had a producer of 40 tons' capacity but it had to be started by coal, and he believed that during the two years previous to the war no trial run had lasted long enough to get rid of the coal that had been used for starting, so that no fair judgment could be formed of it.

Mr. Mansbridge said that the question of having the factories close to the sources of the peat was a great factor in the economical use of peat. In those neighbourhoods labour also was cheap. In the West Midlands they could sell all the peat that they could cut in the summer for 20s. a ton, but in the north of England there was not enough peat. Unless the by-products could be made to pay the cost of everything, the use of peat would not be successful.

Mr. Carruthers Thompson thought that even in districts where peat was plentiful, and where it would be necessary to send 25 miles for coal, it would still be cheaper to cart coal than use the peat even although it was hard and could easily be dried. He thought the peat used at Portadown was more the peat from the surface ground. Hard solid peat was not obtained at a depth of less than 30 feet. At Dumfries the peat had to be brought a distance of 3½ miles, but in many places where there was plenty of good peat there were no industries, and to get the necessary materials there would entail so great a cost that it would be impossible to compete with coal even at its present price.

Professor Cadman said that valuable data had been issued and valuable work carried out on that particular problem by the Research Department of the Canadian Government. The problem would become very much more important when the distribution of power in this country had been reorganised. When the reorganisation in distribution of power took place the manufacture of power on a large scale in peat centres would surely follow. Small coal might be left in the mines in this country but it would be used when power was properly distributed.

Professor Baly said that in England no one had really considered peat for producer plant. The figures he had quoted were for works erected directly on the bog, except those at Portadown. On the bog he saw there was no difficulty in cutting down 30 feet to where the peat was black instead of brown as on top. One point he had forgotten to mention was the relative amount of gas used in the Mond plant for heating the superheater, which was put in between the preheater and the producer itself. The difference between the works he had seen and a certain works in Italy was that the Irish peat had an average water content of 50% and the Italian peat had only 15%, so that in Ireland double the weight of peat had to be used. Each ton of theoretically dried peat gave 88,000 to 92,000 cubic feet of gas. If 39,000 feet of that were used in the superheater it should leave 49,000 to 53,000 to produce 1000 h.-p. per hour from two tons of wet peat. In the case of coal, where good coal was used in a good producer 150,000 cubic feet of gas was obtained, equalling 3000 h.p., weight for weight, therefore 1 ton of coal is equivalent to 6 tons of peat with 50% of water.

Everyone wanted to see the erection of works on the peat bogs. When the question of the redistribution of power came to be considered these proposals would be of serious moment. One of the secrets of Germany's success in this war had been the fact that they had made use of their peat bogs and the by-products. Professor Baly said that he could not take any responsibility for the figures

he had given; they had been published in an Irish journal. He had heard that the Dumfries works had failed from many other causes than the failure of peat. It was not necessary to pay anything for water in the Hamilton Robb works. If there was no river near a works the question of water was of importance. The total amount of water however used in the Mond plant was really very small, as it was all conserved in one way or another. The figures for the cost of power had been calculated for a works actually on a bog.

Manchester Section.

Meeting held at the Grand Hotel, Manchester, on Friday, November 3rd, 1916.

MR. J. H. HOSEASON IN THE CHAIR.

THE TRANSPORT OF CORROSIVE LIQUIDS BY WATER.

BY H. N. MORRIS.

The transport of sulphuric acid and other corrosive chemicals has always been a difficult problem for the chemical manufacturer. No chemist would say that the problem of transport on land was satisfactorily settled. The glass carboy is so fragile, that breakages by rail and by road are a source of continual trouble not only to the manufacturer, and to the road carrier, whose lorries or motor vehicles are damaged, but also to the railway companies whose rolling stock is injured.

It is true that railway and road tanks are used for the conveyance of strong sulphuric acid where there are conveniences for loading directly from storage tanks at makers' works, and for discharging into storage tanks at the consumers' works. This method of delivery is, however, unsuitable for users or manufacturers of sulphuric acid who have no railway sidings, and for those users who require the acid for electrical or other purposes where a pure acid is necessary, nor can it be used for the transport of nitric or hydrochloric acid. Tanks have also been used for transport by canal, and tank boats of special design, provided with partitions arranged to prevent the dangerous shifting of the centre of gravity by the oscillation of the acid, have been constructed, and one patent for an acid tank for canal transport is referred to by Lunge in the last edition of his work on "Sulphuric Acid and Alkali," Vol. I., Part 3. But so far as I have been able to ascertain, these tank boats are not used to any large extent in this country, nor are they suitable for sea transport, with which I propose to deal here.

Riveted or welded steel and iron drums have been used in rapidly increasing numbers since the beginning of the war, especially for the carriage of oleum, the crystalline nature of which makes carboys unsuitable; but strict precautions are necessary if unpleasant results are to be avoided.

The glass carboy remains the safest and the best vehicle for conveyance of ordinary sulphuric acid and practically the only one for the conveyance of nitric and hydrochloric acids. So serious a view did the railway companies take of the risks of carrying these corrosive liquids by rail, that early in 1911 they asked the interested chemical manufacturers of the country to meet their chemists and traffic managers to discuss means of reducing the risks and damage (see Chemical Trade Journal, 1911, p. 508). As a result of these conferences a new set of regulations dealing with the traffic was framed. A carboy was defined as a globular bottle of not more than 12 gallons capacity made of glass not less than ¼ in. thick. Methods of packing and loading sulphuric, nitric, and hydrochloric acids were given, and no doubt some improvement has resulted, but not what was anticipated by the railway companies.

If the troubles of the railway companies are so great, how much greater must be the difficulties of transport of these corrosive liquids by sea, when leakages of the packages or so-called explosions caused by pressure generated in the drums or cases means damage not only to other cargo, but to the ship itself together with the passengers and crew. Some companies will not carry in any form of package, and the business of necessity goes to Germany or some other country from which the steamship companies will carry. In respect of this class of traffic no uniform rules and regulations have been adopted by the steamship companies. Some companies require that sulphuric, nitric, and hydrochloric acids must be carried in small glass bottles (Winchesters) with ground glass stoppers, and that these must be packed in wooden cases in sand or whiting in sufficient quantity to absorb the acid which would leak out if a breakage occurred. Others require that the acids should be in earthenware jars, each of about 2 gallons capacity, provided with screw stoppers and indiarubber washers, and that one, two, three, or four of these should be packed in a wooden case with whiting. Both these methods are very costly, the acid contents in some cases representing only a small fraction of the value of the packages. Other companies will only carry sulphuric acid in small wooden cases lined with lead and each containing about 200 lb. of concentrated acid. If the scrap lead is of value to the consumer this method may be economical, but not otherwise, and lead is of course unsuitable for the conveyance of any other acid than sulphuric.

Last but not least in importance, some companies carry sulphuric acid in wrought iron or steel barrels. It is in this kind of package that large quantities of sulphuric acid have been brought over to this country from America during the last two years with results that have brought the matter before the general public.

In September, 1915, a question was asked in the House of Commons by Mr. Bryce as to whether quantities of sulphuric acid essential to the production of high explosives had been purchased in America, and whether owing to defective methods of shipment there had been loss and delay. In reply it was stated that shipments had been made from America; that in the case of the earlier ships a certain amount of loss was due to the kind of iron drums used; that the best type of drum available was used when the earlier shipments were made, and that the defects in the drums used had been remedied.

It is evident that great care must be exercised in the use of such iron packages. Only strong sulphuric acid or oleum can be carried in them, and even then slight impurities in the acid are liable to cause internal corrosion which on a long voyage would cause evolution of gas, and internal pressure or leakage. It is true that with precautions as to the purity of the acid and the strength and quality of metal used for the drums, and careful examination of each drum and each rivet, the risk of transport in iron or steel drums may be reduced. But it is necessary to provide against accidents. A weak rivet may not be detected before use. The shifting of the ship's cargo may cause one drum to leak, and a leakage of acid from one drum on to the outside of another, if not immediately detected, would cause corrosion and consequent leakage of other drums.

If the drums are used for one journey only, and are sufficiently strong, and flawless, the risks are

reduced to a minimum. But how are the shipping companies to satisfy themselves that this is so? They cannot send a representative to test each drum before the acid is filled into it; and the outside appearance may be misleading, whatever kind of guarantee they may have from the manufacturer or consignor.

This is a question that affects the other cargo carried in the ship, and even the ship itself and the safety of the crew if the consignments of acid are large. Experiences vary considerably in this respect. Whilst I could give some cases in which acid has been shipped in iron drums several thousands of miles, and continually over a number of years with few and insignificant leakages, it could hardly be said that this was a general experience. I could give one case for example in which shipments had been continued for 5 years without accident. At the end of the period very severe damage was caused owing to what was called an explosion of a drum which caused the steamship company to decline further traffic of the same kind. My own experience since the commencement of the war has been most unsatisfactory. It has been far more difficult to obtain drums of suitable quality of iron or steel, and of a satisfactory make; and in the case of supplying acid from one Eastern port to another in large quantities, difficulties have arisen not only on account of the quality of the drums it has been possible to purchase, but also because no steamship company would carry except at impossible rates, and deliveries have had to be made in unusually large consignments, the acid remaining stored in the drums in some cases for several months. The only conclusion one can arrive at is that iron or steel drums are not safe for the transport of sulphuric acid over long distances by sea. The question is, can any better method be devised —any method by which the risks are eliminated or reduced to a minimum and the cost of transport made more reasonable?

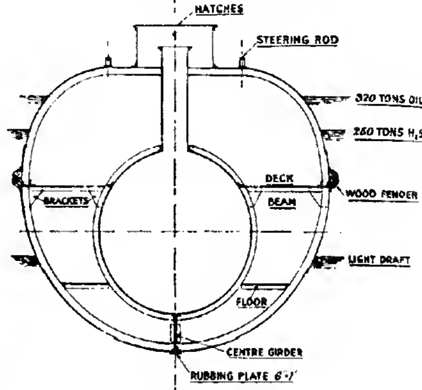
As an attempt to do this, I have to bring forward a proposal for the transport of corrosive liquids by means of a sub-aqueous tank,* to be towed by ordinary liners or by special tug, and which I think will prove to be not only safe to the steamship companies, but for large quantities of liquids and over long distances, cheaper than any of the methods above referred to.

It is about 10 years since the Standard Oil Company first tried an experiment of towing one of the oil barges from the United States to this country. Since then much progress has been made in this method of transport of oil. Tank steamers carrying their usual cargo of petroleum products have regularly towed barges or tanks without any serious disadvantages. Not only have oil barges been towed in this way, but almost wholly-submerged tanks which, of course, are towed with less strain on the towing cable, and at a greater speed. This method of oil transport was described in detail in a paper on "Oil Storage" by Herbert Barringer at a recent meeting of the Institution of Petroleum Technologists.†

There would seem to be no difficulty in carrying out the towing of corrosive liquids in tanks, if suitable tanks and towing arrangements are used.

The vessel that I will describe now in detail, and which I will call the sub-aqueous acid tank, consists of two shells or tanks one within the other, the inner one being eccentric with the outer. The inner tank which carries the corrosive liquid is suitably stayed or braced to the outer one so that it remains in a fixed position, and the space between the two tanks or shells is capable of being sealed and may be wholly or partly filled with water or air to determine the flotation. This tank will float in water and can be submerged wholly or partially as desired by regulating the water in the outer casing. The form of outer casing may be constructed in accordance with any known practice for efficient flotation, and offering least resistance to traction. From the inner shell or tank and projecting through the outer shell in a vertical direction is a pipe or pipes or other form of opening, through which the corrosive liquid to be conveyed is charged or discharged to or from the inner casing, and of course this is provided with a sealed cover. These are the essential features of the sub-aqueous acid tank.

The particular type or design of tank which I have to describe is capable of conveying 250-ton lots of concentrated sulphuric acid. It is, as will be seen from the drawings, 119 ft. 6 in. long by 16 ft. beam, and 13 ft. 6 in. depth; having an internal shell to contain the sulphuric acid, 100 ft.



TRANSVERSE SECTION.

long by 8 ft. diameter. The vessel is transversely divided by four oil-tight bulk-heads at frames 4, 24, 44, and 64. The bulk-heads divide the inner shell into three compartments each 33 ft. 4 in. long and 8 ft. diameter. The forward compartment is shown on the drawing between bulkheads 44 and 64. The whole of the inner shell is divided into three compartments, and for the transport of ordinary sulphuric acid is lined with lead. This has the effect of keeping the acid free from iron, which is most important for some industries, and makes the generation of gas from the action of sulphuric acid on iron impossible. As the action of sulphuric acid on lead is very slight, there would be only a slight depreciation on the tank.

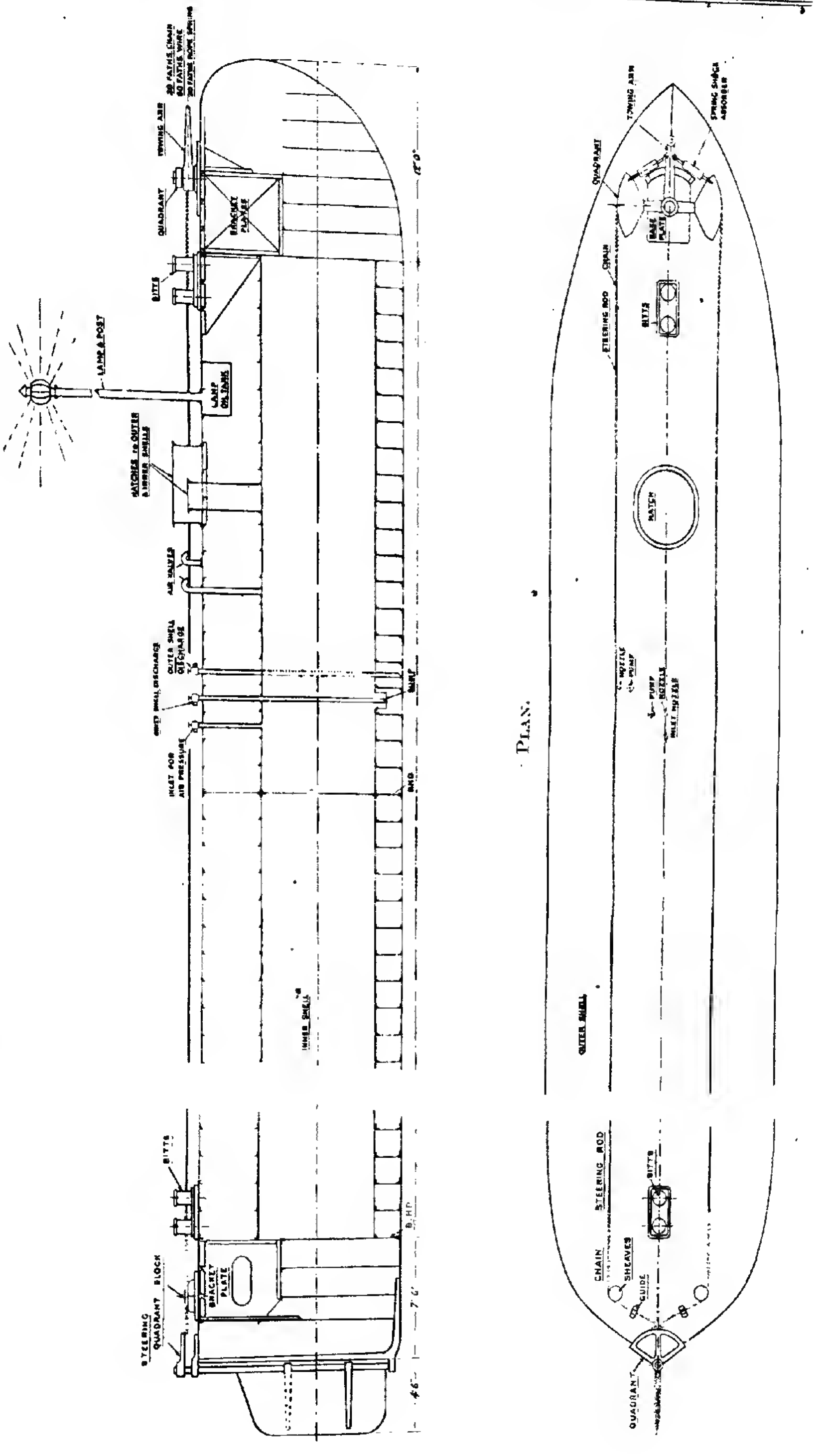
Each of the inner compartments is provided with oil-tight hatches to the inner and outer shells, and is filled or emptied by means of air pressure or hand pumps through pipe lines passing through the hatches. Water-tight air valves are fitted to each compartment to allow for expansion. No steering would be necessary on the open sea where there is little traffic, but if desired the arrangement shown on the drawing can be used. It is a combined towing and steering arrangement. The tow rope is attached to the towing iron, which works a cross-head or quadrant through shock-absorber springs. From this quadrant there is a connection through steering rods and chains to the rudder quadrant. If the sub-aqueous tank goes to one side the rudder is pulled to the other side, and in this way the tank follows the towing vessel.

Barringer in his description of a sub-aqueous oil tank stated "that no means were provided

* See Eng. Pat. 8370 of 1916.

† J. Inst. Petrol. Tech., 1916, 2, 122—158.

SUGGESTED ARRANGEMENT OF BARGE TO CARRY 250 TONS (LIQUID OF 1·84 S.G.). LONGITUDINAL SECTION.



PLAN.

for steering her at all. She was towed with a bridle and the resistance forward to any lateral movement was very slight. A special towing winch was provided which automatically paid out and picked up the tow line according to the strain on it." At the same time he said there were difficulties connected with its navigation in enclosed waters. There, the tow line was brought up much shorter, and when she came into really narrow waters she was taken in charge by a tug. In the case of the much smaller acid tank I am describing, a rudder controlled by a tiller for use in a river or canal ought to be sufficient.

The only danger which I can see in sub-aqueous transport by means of towing is one to which Barringer referred in connection with oil transport. It is the possibility of the breakage of the tow-line and the loss of the tank that is being towed. In such an event the tank might float about, and be a danger to shipping generally. But this is provided against by the use of a light which is kept burning throughout the voyage. It is shown on the drawing. A tank is provided, charged with sufficient oil to keep the light burning for the whole time of the voyage, so that it would be immediately noticed if anything happened to the tow line.

A wooden fender belting, which is shown on the drawing, takes the wear and tear alongside of wharves; and a rubbing plate on the bottom of the structure takes the wear whilst aground. The lower portion of the outer shell is cemented inside to prevent wear; and the whole of the steel work is coated inside with anti-corrosive paint and outside with anti-fouling composition.

The vessel would be about 130 tons weight and would give a draft of about 4 ft. 6 in. when empty. The metacentric height would be 8 in., which is good stability. When loaded with 250 tons of liquid in the inner shell the draft would be about 10 ft. 9 in. and the metacentric height 1 ft. 8 in., which is very stable. If both the inner and outer tanks were filled so far as was safe with oil of sp.gr. 0·8, the contents would weigh 320 tons and the draft would be 12 ft. 6 in. and the metacentric height 3 in.

This sub-aqueous acid tank, as I have shown, will carry 250 tons of ordinary concentrated sulphuric acid. It could be used equally well for oleum, which would solidify but could be easily melted by passing steam into the outer case until the contents of the inner tank were liquid. In this case it would be better not to line with lead, but to use stronger iron.

It could also be used for hydrochloric acid if the lead lining were covered with a uniform coating of bitumen. It could be used for the conveyance of nitric acid if lined with aluminium. As the inner tank is divided into three compartments three different acids or corrosive liquids could be transported at once.

If the corrosive liquids are carried to a port where petroleum or any other oil is produced or from which it is exported, both the inner and outer shell could be filled with oil for the return voyage. If this were not possible a call might be made on the return journey at some port where oil of some kind could be loaded as cargo for the port from which the vessel started. I see no reason why the outer shell, if well dried, should not be used for any form of dry grain such as rice or seed which could be emptied by suction at the destination.

In order to deal with the question in as practical a manner as possible, I have calculated costs based upon a journey by sea of 1600 miles taking a full load of 250 tons ordinary sulphuric acid one way, and returning with petroleum oil of sp.gr. 0·8, which, filled into the inner tanks and into the outer tanks up to a safe level would be 320 tons.

I think that any steamship company ought to be willing to take such a tank in tow as it would involve no risk of any kind to them, but would only cause the boat to make a lower speed, say 10 knots instead of 12, or 8 instead of 10, and thus for a journey of 1600 miles add one day's expenses to the voyage. Although this could be made profitable and safe traffic for any steamship company, I have based the following calculations upon the assumption that a tug is employed of sufficient power to tow with safety the tank I have described with its contents of acid or of oil. I have assumed also that this is for use in the East, and that the bad weather of the monsoon period would put the vessel out of use for 3 months of the year. The vessel weighs 130 tons and the contents (maximum) 320 tons; total, 450 tons. In order to tow this at, say, 9 knots speed a tug of 600/700 I.H.P. would be necessary. It is almost impossible to estimate the cost of such a tug to-day, and I assume that one could be hired for 9 months out of the year for a rent of £1000, exclusive of running costs

I have taken the depreciation on the sub-aqueous tank, which in pre-war times would cost about £2000 and to-day about £5000, at £1000 per annum.

Estimate of a year's work.

Journey, 1600 miles—

Outward trip	250 tons sulphuric acid
Homeward trip	320 tons petroleum oil

Average speed, say 8 knots.

A single voyage would take 8¼ days, and allowing 3 days in port at each end, one round trip would take 23 days and the consumption of coal would be about 190 tons.

Running for 9 months of the year would allow—

11 trips with 250 tons sulphuric acid	2750 tons
11 trips with 320 tons oil	3520 tons
Total tonnage carried	6270
The cost of running the tug for a year would be in wages, stores, upkeep, repairs, etc.	=£1400
Coal, 11 trips at 190 tons=2090 tons, at 20/-	= 2090
Rent of tug for 9 months	= 1000
Depreciation and interest on tank	= 1000
Total cost of running, exclusive of Port dues	£5490
Calculated on 6270 tons	=17/6 per ton.

This freight is on the net weight of the acid and oil carried, and not on packages. If any steamship company would consent to carry acid for the trip that I have taken as an illustration, viz., about 1600 miles, they would ask not less than £2 a ton gross freight on acid carried in earthenware jars in cases. Owing to the weight of the packages being nearly equal to that of the acid contained in them the actual freight on the acid would be, say, £4 a ton; and if the jars and wooden cases were not of value to the consumer, there would be an additional loss in packages which might bring the cost of transport to £6 a ton.

If the steamship company agreed to carry in iron drums, which is a remote possibility, the freight would probably be the same for the 1600 miles' journey, but the drums would not be safe to use for more than two journeys. As the drums cost to-day about £6 per ton of acid and half of this would have to be written off as depreciation, the cost of transport in iron drums would be £5 per ton.

The war has caused many changes affecting the chemical trade and it will cause many changes still. All the regulations of steamship companies respecting the transport of corrosive chemicals have been put aside. We shall start after the war with a clean sheet. It is for the chemists to devise the best methods of packing and carrying acids and other corrosive liquids—the most economical for the manufacturers, and at the same time the safest for the shipping companies. I give this as one suggestion for the serious consideration

of both manufacturers and steamship companies. It is undoubtedly safe for everyone concerned. The only question is whether it is economical. It is not suitable for very small quantities, but for short distances, 100-ton or even 50-ton tanks might be used economically, and there are not many countries where it would not be possible to dispose of 250 tons of either sulphuric acid or mixed consignments. The tank can he used for many acids and other chemicals. I have mentioned sulphuric acid, oleum, hydrochloric acid, and nitric acid, but I might add carbon bisulphide, alcohol, benzol, toluol, or naphtha, which, although they cannot all be classed as corrosive, are more or less dangerous for a steamship company to carry.

In conclusion I wish to express my thanks to Mr. N. K. Turnbull for the assistance he has given me as an engineer in the details of the tank described, and to Lieut. G. K. Turnbull, R.N.V.R., for the valuable criticisms and suggestions his wide experience at sea has enabled him to give.

Discussion.

Dr. J. Grossmann thought it possible that the main cause of difficulty in carrying corrosive liquids in iron or steel drums was owing to the different qualities of iron and steel used in the construction of drums themselves. In the presence of acid, steels or irons of different composition produced at the points of contact electric currents, thus setting up corrosion. He had proved this to be the fact in the case of nitric acid stills, and had been able to prevent corrosion occurring between the running-off pipe and the body of the retort by the adoption of cast-iron studs instead of wrought iron studs in the process of moulding and casting. If some precaution were not taken with regard to the barge suggested, the sea water might similarly produce galvanic action on the inner tube, and this would make the carriage of different acids at the same time a matter of considerable risk.

Mr. L. E. Vlies hoped that Mr. Morris did not propose to transport fuming sulphuric acid in lead-lined vessels, as it was his experience that sulphuric anhydride had a decided action on lead.

Mr. W. F. A. Ermen laid stress upon the difficulty of transport to countries like Brazil, where a kilo. of crude hydrochloric acid of 23% strength cost 1s. 6d. at a works 200 miles in the interior. The acid was delivered in jugs which were practically useless afterwards. The only way to get pure sulphuric acid was *via* Rio de Janeiro, where it was allowed to pass in 500-grm. bottles at a cost of 2s. 6d. per bottle.

Mr. J. D. Paton mentioned that by the use of the "Schoop" process it was practicable to apply a covering of lead or aluminium 1/200th of an inch thick and this was a possible solution of the lining for the storage tank of the vessel described.

A Representative of one of the Indian Shipping Companies stated that they had for many years past carried large quantities of acids to India in jars embedded in whiting in cases on deck and in 'tween decks under certain conditions and there had been no serious complaints. He was of opinion that there would be considerable difficulty in persuading shipowners to undertake towage of a craft of the kind described as far as Bombay.

Mr. K. H. Vakil considered that a further difficulty would arise from the fact that India had very little liquid products to send back in return for the acid if it were delivered in fairly large quantities. It was possible that the outer shell of the barge might be used for the conveyance of Indian vegetable oils, the freight for which at present was exceedingly high.

Mr. Morris, in reply, said there was not likely to be any leakage of the acid into the outer shell, particularly with a strong inner shell lined with lead. In any event if such a leakage did occur it was far better to have it in a tank that was towed behind a tug or liner. He did not see how galvanic action could take place unless there was a leakage either of the lining or of the inner tank itself. He did not regard a lead lining as necessary for the transport of oleum; the iron structure would be sufficient. The tank would not have the same length of life perhaps as one with lead lining carrying ordinary 95% sulphuric acid, but nevertheless it would have a long life if the inner vessel was made strong enough. It had been proved by 10 years' experience with oil tanks that there was very little danger of a properly handled "tow" fouling the propeller of the towing vessel. Whilst he saw no reason why corrosive liquids should not be transported safely and economically over such distances as from this country to India, he thought the proposition was specially applicable to the carrying of such liquids from India itself to different Eastern ports where probably a return cargo of petroleum could be shipped. If acid was sent to a port where there were vegetable oils, then vegetable oils could be brought back.

Industrial Notes.

FRENCH CHEMICAL INDUSTRY.

A report has been issued recently on the work of the *Office des Produits Chimiques et Pharmaceutiques*, which was established in France in October, 1914, as a branch of the Ministry of Commerce. The objects of the Office were to make a census of French chemical and pharmaceutical products, take the necessary steps to assure that their production was not interrupted, and encourage the increased production of existing industries or establish new manufactures where it was thought desirable. The organisation and direction of the Office were entrusted to Professor Béhal, who had the assistance of a "Comité de direction" presided over by the Minister of Commerce, and numerous technical committees to deal with specific industries.

On the outbreak of war, the general mobilisation resulted in the closing of a number of chemical works, and immediate steps were taken to put these again into operation. The supply of the various raw materials for the chemical industries constituted an important function of the Office, and the supplies available after the requirements of the Ministry of War had been satisfied, were distributed as equitably as possible among the various consumers. The Office has also been called upon to advise on the subject of imports and exports of chemical products.

In collaboration with the War Minister, the Office has encouraged the development of existing industries and the establishment of new ones, with a view to making France independent of foreign countries. In the manufacture of dyestuffs, for instance, the production has now reached about 150 tons a month, and is increasing progressively. In this connection, reference may be made to the Compagnie Nationale de Matières Colorantes et de Produits Chimiques, which has recently been established with a capital of 40,000,000 francs, divided into 80,000 shares of 500 fr. each. This company will, it is understood, work in collaboration with British Dyes, Ltd., and will later have the use of certain explosives factories which have been established since the outbreak of war.

The annual consumption of dyestuffs in France

is estimated at about 10.550 tons, made up as follows:—Substantive dyes, 2250 tons; acid dyes, 2500 tons; sulphide dyes, 4250 tons; basic dyes, 700 tons; indigo and other vat dyes, 600 tons; alizarin colours, 250 tons. The total value of these amounts to over £1,000,000.

The general re-organisation of French chemical industry is also receiving the consideration of the Office des Produits Chimiques, which has appointed technical committees to deal with questions such as patents and trade marks, transport, solvents, dyes, pharmaceutical products, synthetic perfumes, etc.

THE SWISS DYE INDUSTRY.

The coal-tar dye industry in Switzerland dates from the year 1859, when the manufacture of Perkin's Mauve was started by the firm of Geigy, one year after the foundation of the British industry. The Swiss firm, established at Basle in 1764, had been engaged since 1856 in extracting natural colouring matters from woods, etc. The manufacture of fuchsin, discovered by Verguin in 1859, was started in Basle by the firm of Gerber-Keller in 1860, and was soon followed by the production of other dyes, many of which are due to the researches of Swiss chemists, Cornu, Graebe, Sieber, Durand, Sandmeyer, Schmid, etc. In 1866 there were four important dye factories in Switzerland, namely, those of Geigy, Gerber-Keller, and Clavel in Basle, and of Petersen in Schweizerhalle. In 1868 a fifth company was established near Geneva, but it ceased to make dyes in 1905. The firm of Petersen ceased to exist in 1908.

At the present time the industry is concentrated in Basle and is in the hands of four companies: the Geigy works in 1914 employed about 700 persons. The Société pour l'Industrie Chimique was founded in 1884 and has a capital of ten millions francs; it took over the business of Clavel, and in 1898 absorbed the Fabrique de Couleurs d'Aniline ci-dev. A. Gerber et Cie., and in 1908 the Basle Chemical Works. In 1914 the firm employed about 2900 persons; since its inception it has paid dividends equivalent to 367½% of its capital, representing an average annual distribution of nearly 12%. The Société Anonyme Durand et Huguenin, founded in 1871, has a capital of 800,000 francs, and the Fabrique de Produits Chimiques ci-dev. Sandoz, established in 1886, is capitalised at between two and three million francs; the latter firm employed about 350 persons in 1914.

Switzerland ranks second to Germany among the dye-producing nations. In 1875 the value of the output of this industry was about 7,000,000 francs. In 1896 Swiss dye exports were valued at 13,910,000 fr.; in 1900, 15,342,000 fr.; in 1905, 20,014,000 fr.; in 1910, 25,414,000 fr.; in 1912, 25,753,000 fr.; and in 1915, about 29,000,000 fr. In connection with these figures it should be remembered that the value of the unit weight of dye produced is now only about 60% of what it was in 1896, so that the increase in quantity manufactured is much greater than is indicated by the figures of value. More than half the exports in 1915 went to England.

The manufacture of synthetic indigo was commenced in 1911 by the Société pour l'Industrie Chimique; in that year the exports were valued at 375,000 fr., in 1912 at 1,509,000 fr., and in 1913 at 3,910,000 fr.

REFRACTORY MATERIALS.

Proc. Faraday Soc., Dec., 1915.

The meeting of the Faraday Society held on November 8th was devoted to a general discussion on refractory materials The meeting opened with an address by the President (Sir Robert Hadfield), and a paper by Dr. J. W. Mellor on "The Texture of Firebricks," abstracts of which appeared in the last issue of this Journal (p. 1218).

Prof. W. G. Fearnsides stated that though there was a great lack of scientific data to help makers of certain types of refractory material, the foremen bricklayers and furnacemen had a great deal of valuable information, which only required to be collected and converted into scientific form. Makers who had obtained some measure of success, and users who submitted the materials to unusual stresses, should work together in overcoming each other's difficulties; if, in addition, the competent scientist also assisted, progress in the refractory-making industry would be much more rapid. Prof. Fearnsides then referred to the pioneer work in the micrographic study of refractory materials, done some fifty years ago by H. C. Sorby, in rubbing down preparations from silica bricks and firebricks to a fair state of transparency. In determining the texture of any brick, the thin slice method can easily be applied. There is great difficulty in attaining a technique that will make evident the character of the "binder." With new-made silica bricks, and especially with firebricks, the determination of the intrinsic structure is not easy: with slices of normal thinness (0·002 to 0·001 inch) newly formed minerals are in such minute crystals that they generally appear as a felted mass. Characteristic inversions of quartz to tridymite and crystobalite in silica brick are comparatively easy to observe, and from structures revealed by the petrographic microscope the heat treatment which a silica brick has received can be judged with fair accuracy. Valuable information could be obtained from an examination of micro-preparations cut from the bricks of the linings of large furnaces at the end of their run.

Dr. R. Lessing having described his method for determining grog and clay in unburned firebricks (this J., 1910, 1219), Dr. H. G. Colman gave a brief account of the work on refractory materials carried out by the Joint Committee of the Institution of Gas Engineers and the Society of British Gas Industries. After determining the conditions prevailing in gas-retort settings, the Committee has drawn up provisional specifications for retort material, ordinary firebrick, and silica brick. Investigations are now in progress on the effect of pressure on the refractoriness of materials, the relative effects of an oxidising and reducing atmosphere, and the influence of the fine flue dust carried into the hot setting on the life of the materials employed. (See this J., 1912, 642.)

Mr. J. A. Howe stated that the Geological Survey was preparing a report on British refractory materials, and for that purpose had divided the country into field areas, taking samples from each and classifying these. Over 1500 samples have been secured, and the collection of the raw material is almost completed. The classification of the data and the examination of the samples is already well advanced.

Mr. T. Crook mentioned that the Empire was well provided with resources of the less common refractories, *e.g.*, graphite in India and Canada, chromite in Rhodesia and India, magnesite in Victoria, South Africa, and British Columbia, bauxite in India and British Guiana, and zircon in Natal.

The use of silica as a refractory material in steel manufacture was next dealt with by Mr. C. Johns (see this J., 1916, 1219).

Mr. A. Cliff spoke on the manufacture of refractory materials, mentioning certain directions for possible improvement; one was in re-working up of old material—one of the best means of eliminating expansion and contraction. He had overcome temporary difficulties due to supply of

materials by fastening working surfaces of chromite, magnesite, etc., to ordinary fire- or silica-bricks. He urged the co-operation of the chemist and the craft in carrying out organised investigations of chromite, magnesite, graphite, and other refractory materials.

Mr. E. P. Page, speaking of the classification of refractory materials, said that a simple method was to divide them into acid, basic, and neutral materials, according to their chemical composition and behaviour. This classification was somewhat arbitrary, because a clay such as china clay would be expected from its composition to be neutral, whilst experience showed that was not the case. It was customary to include all refractory clays in the acid class. The essential property of a refractory was stability at the temperature to which it was exposed, with sufficient reserve of stability to resist externally applied chemical and mechanical influences. In practice it was generally necessary to sacrifice a certain degree of refractoriness *per se* in favour of increased refractoriness against other influences.

Dr. W. Rosenhain spoke of the necessity for paying attention to the highest class of refractories in view of the very high temperatures now employed in metallurgy, especially in the electric furnace. Highly purified zirconia was a very valuable material. A crude zirconia (about 75% ZrO_2) fell far short of pure zirconium dioxide in refractoriness, but bricks made of it would resist temperatures up to about 1600° C. It was much improved by removing the iron oxide by treatment with hydrochloric acid. To get the best results it was necessary to shrink the material at a much higher temperature than it would have to stand eventually. Zirconia bricks as purified for optical purposes fritted above 2000° C. The cracking of refractory materials was caused by forces involving nothing but determinable constants, and the coefficients of thermal endurance could be worked out, as had been done for glass.

Prof. T. Turner, speaking of the relation between porosity and packing of grains, pointed out that round grains do not necessarily give an open and sharp ones a close packing. Small, round particles in the interstices of larger round ones gave the closest grain.

Dr. R. S. Hutton mentioned that the properties of completely shrunk magnesia were quite different from those of ordinary calcined magnesia, and that the shrinking could be economically effected electrically.

Dr. W. H. Hatfield spoke of the work to be done on the resistance of refractories to slag erosion, and gave examples of the great disparity in behaviour of different grades of silica brick.

Prof. F. G. Donnan urged the necessity for a standard quantitative specification for silica bricks.

Dr. P. G. H. Boswell, in a paper on "Refractory Sands," said that these might be divided into three chief classes: (*a*) high silica sands (98·99% or more SiO_2); (*b*) high silica and alumina sands, bearing up to 20% Al_2O_3, as kaolin, etc., and little else but silica; (*c*) sands for greensand moulding, with a strong and highly refractory natural clay bond. All class (*a*) sands hitherto imported may be replaced by British sands. We have also valuable deposits of class (*b*), but as regards the sands of class (*c*), which are used for high-temperature steel moulding, the best foreign sands have not been equalled by known British products. The author indicated certain directions along which research on British and foreign refractory sands was desirable, and concluded by urging co-ordination in the work of all those interested in the subject.

Mr. W. C. Hancock mentioned the application of certain organic dyes in etching refractory materials. This method, in conjunction with that of Prof. Fearnsides, would be of great value in elucidating internal structure.

Mr. E. Griffiths then read a paper on "The Thermal Conductivity of Materials used in Furnace Construction" (see this J., 1916, 1219).

Dr. J. A. Harker mentioned that zirconia, if fine enough, would stand being plunged into water whilst at a white-heat temperature.

Mr. W. Donald wrote that substitutes for Austrian magnesite bricks were being made by adding about 8% of ferric oxide to Greek magnesite, which was too pure. He suggested that when dolomite was used in basic steel furnaces, active calcium ferrates might be formed, the result being destructive to the magnesite foundation.

Mr. A. Reynolds wrote, suggesting that if magnesite nozzles were used for steel ladles, minute particles might get carried forward into the moulds. The higher oxides of iron appeared to increase the refractoriness of bricks exposed to oxidising atmospheres.

Mr. C. R. Darling drew attention to a suggestion, made some years ago, that furnaces should be lagged with a highly insulating substance. Experiments by Fitzgerald and by himself had confirmed the great saving anticipated.

PATENT LAWS AND THE DYE INDUSTRY IN ENGLAND.

BY E. F. EHRHARDT.

Pamphlet published by H. T. Woodrow & Co., 3, Cook Street, Liverpool.

(*Abstract.*)

That the dye industry does not flourish in Great Britain has been attributed, among other things, to the stupidity of British manufacturers that they did not engage chemists, the chemists have been blamed for not possessing the plodding industry of the German chemists, patentees have been blamed for dog-in-the-manger tactics, and the patent-law blamed for favouring foreign inventors, and so on, but in the author's opinion none of these statements affords a true explanation, and the real reason for the position of the industry has not recently been put forward.

The lack of success of the British dye industry is to be attributed to the fact that in this country there is no belief in Patent protection; in the Courts, in the Patent Office, amongst manufacturers, and in the general public, there is no belief in the advantage to the public of an adequate protection to inventors by Letters Patent. The inventor who seeks to patent his invention is regarded not as a benefactor seeking his rightful reward, but as a rather lucky person who has happened upon something new, and who, then, in a dog-in-the-manger spirit, desires to keep it to himself. It is thought to be in the public interest to thwart the inventor in every way possible, to cut down his protection as far as may be, and if possible to destroy it altogether.

Every change that has been made in Patent law and administration in recent years is to the disadvantage of the inventor. If there were a real active belief that by the system of granting patents for inventions, benefits would accrue to the public generally, this would not be the case. The efforts of the statesmen dealing with patent law and the officials of the Patent Office would be directed to extending patent protection rather than to whittling it down as much as possible. There is no case of this.

What can be patented is defined by the Statute of Monopolies in the words, "any manner of new

manufacture." but many inventions that might well be protected by patent can be excluded by deciding that they are not "manufactures." For example, the discovery that dichlorobenzene was a better agent than any hitherto used for protecting furs and woollen materials from the attacks of moths, has been denied patent protection. The Patent Office decided that to use dichlorobenzene exactly as camphor has been used is not a manufacture. In so far as some particular method of applying the dichlorobenzene were necessary, that could be protected, but merely to put the dichlorobenzene in the wardrobe with the furs, that could not be protected. An appeal was taken to the Law Officer of the Crown, but the decision of the Patent Office was upheld.

The expense of taking up inventing as a matter of business is very considerable, and the capitalist can only hope for an adequate return if, whenever some of his chemists succeeded in perfecting a paying invention, adequate patent protection could be obtained for it. With the great uncertainty that exists with regard to the validity of any English patent, and the almost universal attitude towards patents that exists in this country, the investment necessary to establish a research laboratory would be almost certainly doomed to failure. That is the reason why this kind of investment has not found favour in this country, although elsewhere it has been adopted with very great success.

In order to combat the dog-in-the-manger spirit that is supposed to animate patentees, machinery has been devised by which a patentee can be compelled to grant a licence. What compensation should be regarded as adequate? The answer is contained in the words of the Letters Patent, "that the inventor should have the entire benefit of his invention." If he is compelled to grant licences he should not thereby forego any benefit from the invention. There might be cases in which the licensee could see an advantage to himself by having a licence without diminishing the reward of the inventor. In such cases a compulsory licence might well be granted.

The author disputes the existence of an unjustifiable dog-in-the-manger spirit, and denies that any such spirit has injuriously affected the colour industry in this country, instancing the fact that many licences have been granted by German firms, whilst others have been offered but not taken up in this country. English manufacturers are not blamed for refusing the licences offered them, any more than are English capitalists for not taking up the business of inventing colours. It is due to the uncertainty of the Patent law, which makes either of these investments too precarious for a wise man to contemplate.

What is required, in the first place, is a realisation of the enormous importance of inventions for the national prosperity, and indeed, possibly, for the national existence, and secondly more universal recognition is required, that inventions are a property which need just as jealous protection as land and houses or wealth in any tangible form. Without the possibility of obtaining nitric acid from the air, and so being independent of saltpetre from Chili, it would have been impossible for Germany and her Allies to have continued this present war so long. The patent for Schönherr's furnace and his process of making the oxides of nitrogen was only granted in the English Patent Office after a severe *ex parte* contest on an appeal, with the assistance of Counsel.

To avoid the very heavy expense of litigation in patent cases, the author suggests abolishing as a defence in Patent lawsuits the allegation that the patent is invalid, for any reason whatever. Let the question of infringement, a simple question of fact, be the only issue, the validity of the patent standing proved by its grant. If anyone desires to dispute the validity of a patent let him do so before he commences to infringe, independently of any infringement proceedings, by petition for revocation, which in the first place should be addressed to the Patent Office, and this right to attack a patent as invalid should lapse five years after the grant of the patent. Patent applications are subjected in the Patent Office to a most stringent search; after they have passed through this ordeal everyone who desires it should have an opportunity of making good any objections to the validity of the patent within a period of five years after the grant. After that the patent should stand, and not be liable to an attack. The question of infringement should always be a question for the courts, and simply a question of fact. In the case of product patents this would be so simple a matter that infringements would hardly occur.

If this plan were adopted it would throw a good deal more responsibility on the Patent Office. The last Patent Act made the Patent Office responsible for the conformity between provisional and complete specification. Now if the Patent Office passes the complete, the objection of lack of conformity cannot be raised. The result has been, in many cases, that the provisional specification is practically abolished. The Patent Office appears to evade the responsibility by simply using all its influence to prevent any alterations being made as between provisional and complete, and it is a rare thing now in dyestuff patents to find a real provisional specification followed by a complete specification. It would appear a bad change for the inventor that the responsibility for the validity of his patent should be thrown upon the Patent Office, and indeed it is essential that the Patent Office must be animated by the feeling that it is its duty, whenever a real invention has been made and brought to its notice, to see that the utmost possible protection should be granted for that invention. The Patent Office seems to regard the interests of the inventor and of the public as antagonistic, and to endeavour to limit as much as possible what the patentee can retain for himself, and what he must leave to the public. This is the wrong spirit, for it is to the interests of the public that inventions should be made, and when made inventions should be adequately protected.

It is also suggested that the duration of Letters Patent should be longer. It is seldom that a patent can be worked at a profit for three or four years after the invention, so that the patentee only enjoys the monopoly for about ten years. Twenty years for the nominal duration of Letters Patent instead of 14 is none too long.

Radical alterations are desirable in the practice at the Patent Office in several respects. The manner in which the search and the correspondence with the inventor in connection with the search is carried on seems to be most irritating. Although Letters Patent date from the date of application, so that whether the search takes a short time or a long time, the duration of the protection is in no way affected, a time limit is placed upon the negotiations between the Office and the inventor. The greater part of the time is occupied by delays on the part of the Office. Every patentee desires to get his patent as quickly as he can, and he will not delay doing all that he can to reply to the Patent Office and remove the objections of the officials. For the Office to take three or four times as long dealing with the inventor's letters as the inventor takes to deal with the Office letters, and then to demand extra fees because agreement is not yet attained, is almost intolerable.

There is also an enormous waste of energy involved in the present system of going through a search for all the applications that are filed. It is probably less than 20% of the applications that survive the payment of the second fee that

falls due at the end of the fourth year. By the time this fee is payable the inventors, in four cases out of five, have realised that their invention is of no use, and will not spend another £5 to keep the patent already granted in force. If the search were postponed, except when the patentee particularly applied for it, for four years, more than half the work of the Patent Office could be saved, and again, if the specifications which the inventors themselves recognised as useless were not published until they had undergone the search, the volume of trashy patents would be very much diminished. This would simplify subsequent searches.

Too much is expected from printed specifications. When the grant of patents came to be restricted to inventions the term of 14 years was chosen because it was twice the usual term of apprenticeship, the inventor was supposed to teach his apprentices the invention. By the time they had served their apprenticeship they were to be as expert as himself, but he would be able to engage the services of the first set of apprentices for a further seven years, and have no competition to fear from them, and at the end of 14 years two sets of his apprentices could produce the invention, and so it might become generally known. Now, the specification is supposed to take the place of training apprentices, the specification is supposed to put others in a position to manufacture according to the invention as well as the inventor. This is expecting impossibilities, in the case of complicated chemical manufacture. It is sometimes possible by a printed description to give all the information necessary to a chemist to prepare the patented article with a little practice, as well as the inventor himself, but this is exceptional. The office of the specification should be regarded as more for identifying the invention than of teaching others how to carry the invention into practice. At the best the specification can only describe what the inventor knows at the time when the specification is written. This in the case of chemical invention is nearly always laboratory experience. The invention is made and worked out in the laboratory, and if of sufficient promise is patented from the laboratory; then comes sometimes very difficult work to carry out the invention in the factory. It is sometimes years before a regular manufacture can be begun, and then month by month improvements suggest themselves, and at each alteration or extension of the plant these are embodied until the patentee who is manufacturing can do very much better than anyone starting with the specification drawn up when first the invention was made. Too much importance is attached to the idea that the specification should teach others after the patent has lapsed how to carry out the invention. The people to be mainly considered in connection with the grant of Letters Patent are the inventor and the consumer of the invented article, not the competitors of the inventor, and especially not competitors that may arise after the patent lapses. If this country were to adopt the policy of giving generous protection to inventors there would soon be a large number of manufacturers who would be patentees and would feel interested in patent rights being respected. That is the only spirit upon which the vital extensions of the dye manufacturing industry in this country can be based. No industry was ever established anywhere by compulsory licences or compulsory working. No healthy industry can be established by taking inventions without recompense to the inventor. The dye industry above all others is being constantly fed by a stream of inventions. Where inventions are most secure property there the industry will flourish. Make chemical invention pay and there will be plenty of chemists of plodding industry to do the work and manufacturers not too stupid to employ them.

Journal and Patent Literature.

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I.—GENERAL; PLANT; MACHINERY.

PATENTS.

Filtration and/or percolation of liquids. C. Yeoman, London. Eng. Pat. 14,287, Oct. 8, 1915.

LIQUID to be filtered is supplied automatically in proper quantity to a filtering funnel. The liquid is contained in an inverted bottle or the like, preferably supported on an adjustable stand, and having its neck immersed in the liquid in the funnel. Alternatively the container may be supported on a collar resting on the receiving vessel. When the funnel fits tightly into the neck of the receiver, air escape openings may be provided or a filter pump may be used. The outlet of the container may be slanting and it may be provided with a valve. The container may be connected to a supply tank and may be surrounded by a heating coil.—W. F. F.

Exhausting air and non-condensable gases; Apparatus for ——. A. E. L. Scanes, Ashton-on-Mersey. Eng. Pat. 15,771, Nov. 8, 1915.

THE air is aspirated by a steam ejector and the mixture of air and steam is delivered to the final stage of a multiple-stage water ejector. A by-pass is provided so that any air which is not carried forward by the final stage of the water ejector passes back to the first or second stage of the water ejector and is compressed and driven forwards. —W. H. C.

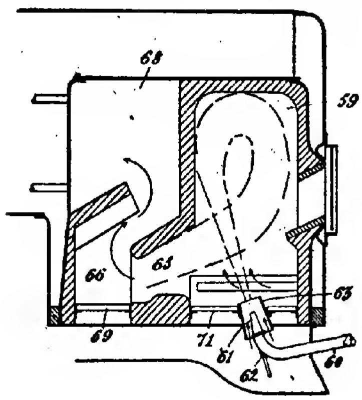
Vacuum; Centrifugal apparatus for the stepwise production of a ——. J. H. Storm, jun., Amersfoort, Holland. Eng. Pat. 101,935, May 18, 1916. (Appl. No. 7114 of 1916.)

EXHAUSTING drums, as described in Eng. Pat. 21,508 of 1914 (this J., 1915, 999), are arranged in series, and rotated on a common shaft. The first drum of the series discharges into the open air and draws air from a casing which surrounds the second drum of the series, and so on to the last drum which draws air from the space in which a vacuum is to be produced.—W. H. C.

Furnaces fed with pulverulent fuel. K. H. V. von Porat, Stocksund, and Motala Verkstads Nya Aktiebolag, Motala Verkstad, Sweden. Eng. Pat. 16,298, Nov. 18, 1915.

POWDERED fuel is blown through the pipe, 60, and nozzle, 61, steam is injected through the pipe,

62, and air is induced through the pipe, 63. The fuel jet is deflected by the walls of the chamber, 59, forming a loop, to the outlet, 65 A grate, 69, for solid fuel, or a gas burner, is provided for igniting the mixture of powdered fuel and air, which then passes through a curved channel, 66,



to the combustion chamber, 68. Before the use of powdered fuel is commenced, firing by means of solid or liquid fuel on the grate, 71, may be used. Alternatively the fuel may be injected into a lateral chamber before passing into the mixing chamber, 59, to prevent pre-ignition. A deflecting screen may be arranged at the entrance to the mixing chamber or a deflector may divide the mixture into two parts.—W. F. F.

Shaft-furnaces and kilns. R. Thiele, Höxter-an-der-Weser, Germany. Eng. Pat. 101,937, May 30, 1916. (Appl. No. 7662 of 1916.)

THE kiln is provided with two grates, situated side by side, which receive a horizontal reciprocating motion by means of shafts passing air-tight through packing boxes and connected by pitmans with cranks set at an angle of 180° to each other on opposite sides of the driving shaft. The grates are formed with a central grid portion having bars set at an oblique angle to the direction of motion, and end plate portions having teeth and perforations, and are so arranged that only the plate portions pass beneath the open bottom of the kiln. The outlet shoot is provided with an air lock having two doors which are opened alternately by mechanism.—W. H. C.

Liquid fuel furnaces. W. A. White, New York. Eng. Pat. 101,947, July 11, 1916. (Appl. No. 9767 of 1916.)

THE furnace has a double-walled, hollow front in the centre of which a spraying device for the liquid fuel is set. Air is admitted to the hollow front, which is provided with tangential ribs to impart a whirling motion to the air before it enters the combustion chamber through an annular opening which surrounds the front of the spraying device.—W. H. C.

Mixing machines for granular or pulverulent substances. G. Porteous, Leeds. Eng. Pat. 17,659, Dec. 17, 1915.

To prevent "bridging," the chambers of the mixing machines are constructed with gradually increasing cross-sectional area from the top to the bottom.—W. H. C.

Mixing machines. T. Monk, London. Eng. Pat. 102,007, Mar. 9, 1916. (Appl. No. 3526 of 1916.)

A TROUGH having a hemicylindrical bottom is pivoted on a longitudinal horizontal shaft so that it may be tilted. Inclined blades with lateral projections are mounted to rotate with the shaft, and alternate fixed radial members are threaded on the shaft and secured at their opposite end to the trough. Locking devices are provided to fix the trough in its tilted position when required.—W. F. F.

Generation of steam and the heating of liquids generally. P. St. G. Kirke, London. Eng. Pat. 17,842, Dec. 21, 1915.

THE heating tubes are filled with packing pieces so formed that they present faces inclined, preferably at a right angle, to the main direction of the gases through the tubes.—W. H. C.

Dust separator for granular materials. T. Robinson and Son, Ltd., C. J. Robinson, and T. J. Stevenson, Rochdale. Eng. Pat. 102,010, Mar. 25, 1916. (Appl. No. 4423 of 1916.)

IN a dust separator of the type described in Eng. Pat. 8592 of 1906, the hopper for the granular material is provided with radial plates projecting inwards to prevent rotation of the material delivered from the spreader plate, and thus permit higher speeds to be used without loss of material over the edge of the hopper.—W. F. F.

Electrolytic tank; Acid-proof and ——. R. T. Wales, Sewaren, N.J. U.S. Pat. 1,202,457, Oct. 24, 1916. Date of appl., Apr. 1, 1914.

THE tank is composed of a substantially rigid supporting bed, with a course of brick thereon spaced apart, and a bottom lining wall composed of blocks laid in acid-proof cement. Side lining walls and partition walls are built up of similar material, with an exterior rigid wall spaced apart from the side walls. Material, such as pitch, is disposed in the spaces between the side walls, and in the spaces throughout the course of brick upon the bed, the latter material communicating with the pitch between the side and exterior walls.
—B. N.

Centrifugal extractor; Electrically operated ——. W. Bartholomew and C. H. Allen, Assignors to Troy Laundry Machine Co., Ltd., Chicago, Ill. U.S. Pat. 1,203,567, Nov. 7, 1916. Date of appl., Feb. 20, 1913.

IN a centrifugal extractor, a rotating basket is provided with a cover which is locked in closed position during rotation. A bolt carried by the cover is reciprocated by its opening and closing, and is prevented from moving into its open position by the interposition in its path of the armature of an electro-magnet. The circuit of the electro-magnet is independent of the circuit of the motor driving the extractor and is controlled by the rotating basket.—W. F. F.

Air or other gaseous fluids; Utilising the energy of moving bodies of ——. G. J. Gawley, Fleet, Hants. Eng. Pat. 15,914, Nov. 11, 1915.

A DISC is provided with a spiral rib on one face forming a spiral groove; this rib fits accurately into the groove on the face of another similar ribbed disc. The central point of the spiral is provided with a hand-operated valve and the terminal point with a non-return valve. When the two discs are separated, a vacuum is formed in the spiral groove, and when the central valve is opened air enters, acquires kinetic energy in traversing the groove, and may be used at the outer end for doing work.—W. F. F.

Heating liquids; Method and apparatus for ——. The British Westinghouse Electric and Manufacturing Co., Ltd., London, Assignees of L. W. Chubb, Pittsburgh, U.S.A. Eng. Pat. 100,796, June 28, 1916. Under Int. Conv., June 30, 1915. (Appl. No. 9111 of 1916.)

THE liquid container, *e.g.*, a steam boiler, is coated internally with aluminium, and a small amount of electrolyte such as a mixture of boric acid and borax is added to the liquid so as to produce an asymmetric electric conducting film on the aluminium. An electrode is placed in the liquid, and a difference of potential of about 300 volts is maintained between the liquid and the container. The rate of transfer of heat from an external heater to the liquid is thereby increased. If an alternating electromotive force is applied, the electrode is provided with a similar film.—W. F. F.

Heating gases; Means for ——. J. Weber, Essen, Germany. U.S. Pat. 1,203,944, Nov. 7, 1916. Date of appl., Mar. 13, 1916.

THE apparatus comprises a pair of furnace chambers, opposite each other, and each divided into upper and lower compartments. An inclined rotary drum extends from the upper compartment of one chamber to the upper compartment of the other, and a second rotary drum, inclined in the opposite direction, extends between the two lower compartments; the drums have projections on their inner surfaces. Solid particles are fed into the upper end of the upper drum and are discharged from the lower end on to a roller with recesses on its surface; the roller delivers the solid particles into the upper end of the lower drum. The gas to be heated passes upwards through the two drums in succession.—A. S.

Evaporation of fluids; Apparatus for the ——. F. P. Bergh, J. Loebinger, and H. C. Neuberger, Assignors to General Reduction Co., New York. U.S. Pat. 1,204,121, Nov. 7, 1916. Date of appl., Apr. 14, 1911; renewed Apr. 10, 1916.

THE apparatus consists of a polygonal chamber provided at one side near the top with a spraying device which projects a spray of liquid across the chamber. Heated air or gas is admitted lower down the chamber, and passing upwards through the spray effects the evaporation. The gas escapes through a pipe near the top of the chamber above the spraying device, and the concentrated liquid collects in the lower conical portion of the chamber.—W. H. C.

Gaseous mixtures; Apparatus for the separation of ——. H. van Fleet, Ardmore, Pa., Assignor to American Air-Liquefying Co., New York. U.S. Pat. 1,204,521, Nov. 14, 1916. Date of appl., Apr. 18, 1914.

A GASEOUS mixture is supplied to a "header" at its opposite ends and passes through horizontal coiled pipes to a second "header." The gas is wholly or partly liquefied in the pipes and the liquid passes to a receiver. A helical coil connected to the top of the second "header" surrounds the two "headers" and the horizontal pipes, and is connected to a third "header." All these parts are wholly or partly submerged in one of the liquefied constituents of the mixture, and separate means are provided for conveying liquefied gas from the receiver and the third "header."—W. F. F.

Drying vegetable materials. H. Brune, Neustadt, Germany. U.S. Pat. 1,204,845, Nov. 14, 1916. Date of appl., Feb. 13, 1913.

WET vegetable materials are mixed with previously dried similar material and the mixture pressed to extrude moisture.—W. F. F.

Separating, cleaning, or emulsifying liquids; Machines for ——. B. E. D. Kilburn, London. From J. W. Davies, Boston, Mass., U.S.A. Eng. Pat. 16,090, Nov. 15, 1915.

SEE U.S. Pats. 1,200,559 and 1,200,560 of 1916; this J., 1916, 1208.

Filter; Rotary ——. R. P. Akins, Assignor to Colorado Iron Works Co., Denver, Colo. Reissue No. 14,214, Nov. 14, 1916, of U.S. Pat. 1,059,327, Apr. 15, 1913. Date of appl., July 28, 1916.

SEE this J., 1913, 740.

Evaporator. J. Harris, Sheffield, and D. H. Thomas, Morriston, Wales. U.S. Pat. 1,203,614, Nov. 7, 1916. Date of appl., Nov. 29, 1915.

SEE Eng. Pat. 23,414 of 1914; this J., 1915, 894.

Evaporation and distillation of liquids; Method of ——. C. T. Thorssell, Gottenborg, Sweden. U.S. Pat. 1,204,710, Nov. 14, 1916. Date of appl., Sept. 8, 1914.

SEE Eng. Pat. 9295 of 1914; this J., 1915, 538.

Tube-mill. J. S. Fasting, Frederiksberg, Denmark, Assignor to F. L. Smidth and Co., New York. U.S. Pat. 1,204,554, Nov. 14, 1916. Date of appl., Apr. 28, 1915.

SEE Eng. Pat. 7160 of 1915; this J., 1916, 294.

Apparatus for expressing liquid from materials containing the same. Eng. Pat. 101,782. *See* IIA.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Galvanic fuel cells at high temperatures. Baur and others. *See* XI.

PATENTS.

Spiral [coal] separators. F. Pardee, Hazleton, Pa., U.S.A. Eng. Pat. 102,106, May 3, 1916. (Appl. No. 6359 of 1916.)

IN a spiral separator as used in coal breakers for removing slate and "bone" from the coal, divergent creases are formed on one or more of the plates forming the runways, the creased surfaces leading to uncreased gravitative surfaces on the same plates. The creased portion of the runway may be perforated.—J. E. C.

Vertical retorts; Discharging apparatus for ——. S. Glover, St. Helens, and J. West, Southport. Eng. Pat. 102,093, Aug. 8, 1916. (Appl. No. 3731 of 1916.)

IN discharging apparatus for vertical retorts, an oscillating trough forming the water seal is fitted with a raised portion acting as a stop to ensure that the trough shall carry coke with it when moving in one direction, this raised portion being so shaped as to prevent coke falling behind its forward end.—J. E. C.

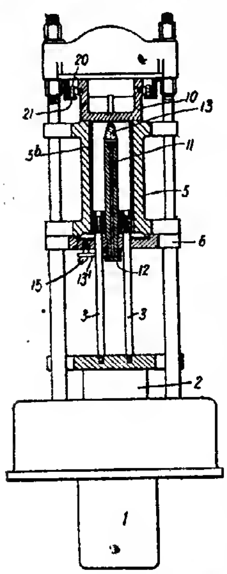
Retort. Process of obtaining coke and by-products from coal. H. P. Bostaph, Detroit, Mich. U.S. Pats. (A) 1,204,646 and (B) 1,204,647, Nov. 14, 1916. Date of appl., Jan. 19, 1916. (A) Renewed Sept. 16, 1916.

(A) A RETORT for the destructive distillation of coal consists of an outer shell and an inner central duct, the space between being divided into narrow wedge-shaped compartments by radial divisions. Heat is applied at the outer edges, and the gases of distillation are withdrawn by way of the central duct. (B) Coke is produced from coal by sub-

jecting the coal in relatively thin masses to heat directed against one edge of the mass and withdrawing the products by suction from the opposite edge. The greatest thickness of the mass should not exceed four inches.—J. E. C.

Peat; Process for expressing liquid from ——. Apparatus for expressing liquid from materials containing the same. J. W. Hinchley, London, and G. Gorton, Bexhill-on-Sea. Eng. Pats. (A) 3998, Mar. 13, 1915, and (B) 101,782, Mar. 13, 1915. (Appl. No. 14,576 of 1916.)

(A) A MIXTURE of peat composed of the upper and lower layers of bog, containing a substantial quantity of fibre, is subjected, without preliminary heat treatment and at ordinary temperature, to a pressure of about 1000 lb. per sq. in., preferably in a hydraulic press. The pressure is reduced to about 200 lb. per sq. in., and steam or hot air at this pressure is forced through in a direction at right angles to the movement of the press. A final pressure of 1100 to 1500 lb. per sq. in. is then applied to express as much of the remaining liquid as possible. The resulting cake may be used as fuel, or carbonised for the production of by-products. (B) A press suitable for the process described in (A) comprises a hydraulic cylinder, 1, ram, 2, and rods, 3, supporting an annular piston, 4. The inner walls of the pressing cylinder, 5, have longitudinal grooves covered by a wire gauze strainer, 5b. A cover, 10, carries rollers, 20 which run on rails, 21, so that it may be removed when the cylinder is to be charged. Steam or hot air is admitted by the passage, 11, to the conical outlet, 13, which is perforated and covered with a wire gauze strainer and perforated cap. Steam and condensed water are discharged through the strainer, 5b, and pipe, 15. During the preliminary compression expressed liquid is discharged through the strainers, 5b, and 13, and pipes, 15, 13¹. In a modification, the pressing cylinder is provided with an additional annular grooved wall with strainer, and an additional annular steam nozzle, both reaching nearly to the top of the cylinder. Three annular concentric pistons are then used, while the communicating space at the top equalises the pressure. The steam-tube, 11, is secured to the support, 6, by a screwed cap, 12, to minimise the height of the press.—W. F. F.



Regenerative [gas retort] furnace. Drakes Ltd., and W. A. Drake, Halifax. Eng. Pat. 101,983, Jan. 3, 1916. (Appl. No. 7 of 1916.)

THE hot waste gases pass downwards through a vertical flue and through a series of separated superposed horizontal flues into another vertical flue provided with a regulating damper at its outlet to the chimney. The air to be heated passes from a horizontal flue upwards on both sides of and between the heating flues into horizontal outlet flues provided with a regulating damper or dampers at their inlet ends. The heated air then passes to the combustion chamber.—W. F. F.

Gas producer. L. Nelson, Wellington, N.Z., Assignor to A. S. Cambridge, Auckland, N.Z. Eng. Pat. 16,088, Nov. 15, 1915. Under Int. Conv., May 20, 1915.

IN a producer of rectangular or oval cross-section, acting on the down-draught principle, a pipe of oblong section is suspended from the top equidistant from the sides and above the combustion zone. The tarry vapours from the upper layers pass into this pipe along with the air or air and steam supply. The tarry vapours and air are thus conducted to the combustion zone in which the tarry matter is decomposed. The grate is supported on brick pedestals to take the weight of the fuel off the grate as much as possible.—J. E. C.

Gas producer. C. D. Nordensson, Springfield, Ohio, Assignor to G. A. Southwell, Chicago, Ill. U.S. Pat. 1,203,246, Oct. 31, 1916. Date of appl., Feb. 25, 1916.

IN a down-draught gas producer, a mixture of air and vapour is admitted from a vaporiser to the upper portion of the fuel bed and to an intermediate part. An inverted V-shaped fuel deflector is fitted at the bottom of the fuel chamber and the gases produced pass round the lower edge of the deflector to an exit pipe.—J. E. C.

Liquid fuel. F. C. Axtell, New York. U.S. Pat. 1,204,638, Nov. 14, 1916. Date of appl., Sep. 5, 1916.

A LIQUID fuel consists of a mixture of about 20 vols. of kerosene, 10 vols. of light hydrocarbon distillate, 10 vols. of alcohol (95% vol.), and 4 vols. of anhydrous fusel oil.—J. E. C.

Petroleum; Process of reducing crude ——. C. Forward, Urbana, Ohio. U.S. Pat. 1,202,823, Oct. 31, 1916. Date of appl., Mar. 23, 1916.

HYDROCARBON oil is atomised by superheating vapours in a suitable chamber in which a uniform pressure of 50 lb. and upward and a uniform temperature of 400° F. (about 200° C.) and upward is maintained by the injected vapours. The liquid and volatile products are drawn off separately at such a rate as to maintain the conditions in the chamber. The liquid products pass into one or more succeeding chambers, and undergo similar treatment for the recovery of additional volatile oils.—J. E. C.

Hydrocarbons; Treating —— and products therefrom. W. M. Cross, Kansas City, Mo., Assignor to Gasoline Products Co. U.S. Pat. 1,203,312, Oct. 31, 1916. Date of appl., Jan. 9, 1915.

A CONVERTER is partially filled with hydrocarbon oil so as to leave a vapour space above the main body of oil. A portion of the oil is circulated through a series of heated pipes and returned to the converter, a vapour pressure out of proportion to the temperature being produced. The vapours are removed and condensed.—J. E. C.

Oil; Apparatus for purifying ——. O. J. Shiner; M. E. Shiner, administratrix, Assignor to T. A. Murphy, Bayonne, N.J., L. B. Wight, Washington, D.C., and M. A. Davidson, Elizabeth, N.J. U.S. Pat. 1,203,419, Oct. 31, 1916. Date of appl., May 1, 1913.

THE invention comprises a series of closed tanks for treating oil with acids or other chemicals and washing it. The oil is conveyed through the tanks in a continuous stream.—J. E. C.

Lignite; Process of treating ——. C. Melhardt, Starnberg-Munich, Germany. U.S. Pat. 1,205,007, Nov. 14, 1916. Date of appl., Jan. 20, 1915.

SEE Eng. Pat. 24,299 of 1914; this J., 1916, 526.

Water-gas and like products; Producers for ——. H. S. Jones, London. From Dellwik-Fleischer Wassergas Ges., Frankfort, Germany. Eng. Pat. 18,218, Dec. 31, 1915.

SEE Ger. Pat. 287,616 of 1914; this J., 1916, 246.

Oils; Apparatus for the distillation of ——. S. J. Ross and H. Schofield, London. U.S. Pat. 1,204,492, Nov. 14, 1916. Date of appl., Dec. 22, 1915.

SEE Eng. Pat. 15,538 of 1914; this J., 1916, 298.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

PATENTS.

Coal; Low-temperature distillation of ——. H. A. Kuhn, Pittsburgh, Pa. U.S. Pat. 1,204,789, Nov. 14, 1916. Date of appl., Feb. 29, 1916.

COAL is distilled in a retort having two distinct zones. In the first (vertical) zone a primary distillation of coal dust is effected, the solid residue being conveyed through the second (horizontal) zone. The chambers are heated externally by a current of hot gases at a temperature varying from 900° to 1200° F. (about 480° to 650° C.).—J. E. C.

Gas [heating] furnace. J. Lehmann, Bochum, Germany. Eng. Pat. 101,077, May 4, 1916. Under Int. Conv., July 30, 1915. (Appl. No. 6439 of 1916.)

IN a gas heating furnace the gas or combustion air is admitted to one end of a recessed channel on the inside of the furnace wall. Combustion takes place when the gas or air leaves the conducting channel, and a longer flame is produced. If desired both the gas and the air may be introduced into separate channels formed in the furnace wall.—J. E. C.

Filaments for incandescence electric lamps; Process of manufacturing ——. F. Baumann. Assignor to Wolframlampen A.-G., Augsburg, Germany. U.S. Pat. 1,205,080. Nov. 14, 1916. Date of appl., Mar. 8, 1913.

SEE Fr. Pat. 457,096 of 1913; this J., 1913, 1002.

Attachment for miners' electric safety lamps for detecting firedamp and other combustible gases. Eng. Pat. 15,094. *See* XXIII.

Improvements in photometers, especially sector photometers. Eng. Pat. 15,663. *See* XXIII.

III.—TAR AND TAR PRODUCTS.

Sulphurous acid esters; Aromatic ——. M. M. Richter. Ber., 1916, 49, 2339–2345.

AROMATIC esters of sulphurous acid were obtained by the action of thionyl chloride on phenols in presence of sufficient pyridine to combine with the hydrogen chloride formed, the reaction being carried out in a suitable neutral solvent, such as carbon bisulphide, ether, or benzene. The reaction products, freed from pyridine hydrochloride by filtration, gave, on evaporating the solvent *in vacuo*, an analytically pure sulphite. Diphenyl and the ditolyl sulphites are yellowish liquids having a faint sulphurous odour. They are remarkably stable towards water and alkalis, and can be distilled *in vacuo* with but slight decomposition. The dinaphthyl sulphites are white crystalline substances which become discoloured on keeping. The β-sulphite is very sensitive to water, the α-isomeride, on the other hand, stable. Di- and hexa-chlorodiphenyl sulphites were obtained as crystalline substances, which water immediately decomposed into the free phenol and sulphurous acid. The hexabromo-compound appeared to be more stable.—G. F. M.

PATENTS.

Pitch and the like; Method of and apparatus for handling ——. J. C. Mann, West Bromwich, and H. W. Robinson, Rugeley. Eng. Pat. 101,988, Jan. 15, 1916. (Appl. No. 652 of 1916.)

A STEAM-JACKETED spreader delivers the pitch or the like on to a conveyor which passes through a trough of water and is also cooled by jets of water. The brittle material is broken into fragments at the end of the conveyor, for example, by an eccentric roller.—F. W. A.

Toluene and benzene from xylene and cymene; Production of ——. W. F. Rittman, New York, Eng. Pat. 13,100, Sept. 13, 1915. Under Int. Conv., July 7, 1915.

SEE Fr. Pat. 479,786 of 1915; this J., 1916, 1103.

IV.—COLOURING MATTERS AND DYES.

Coal tar colours; Physiological and pharmacological studies on ——. *Fat-soluble dyes.* W. Salant and R. Bengis. J. Biol. Chem., 1916, 27, 403—427.

THE action of the following dyes was investigated: Benzeneazo-β-naphthylamine (Yellow AB), tolueneazo-β-naphthylamine (Yellow OB), benzeneazobenzeneazo-β-naphthol (Sudan III), benzeneazo-β-naphthol (Sudan I), benzeneazodimethylaniline (Butter Yellow), benzeneazophenol (Oil Yellow), benzeneazoresorcinol (Sudan G), and aminoazobenzene (Spirit Yellow); these were administered subcutaneously, intraperitoneally, intravenously, and by mouth to rabbits, and, in a few cases, to cats and rats. The effect of renal disturbance on the elimination of the dyes was determined by the administration of zinc malate and of chenopodium oil. It was found that the dyes were eliminated in the urine and in the bile, but that the elimination in the urine was usually inhibited in poisoning with zinc or chenopodium oil. The greater part of the dyes was deposited in the adipose tissues; staining of the nervous tissue, the kidney, and muscle was also noticed in some of the experiments. Dye was still present in the blood 15 hours after the intravenous injection of 25 mgrms. of benzeneazoresorcinol per kilo. of animal. Two of the compounds of benzeneazophenol and benzeneazoresorcinol, which were isolated from the urine of rabbits, proved to be conjugated with glucuronic acid. The toxicity of the various dyes was not pronounced even when large doses were administered.—W. P. S.

PATENTS.

Azo-dyestuffs; Manufacture of chromium compounds of —— *containing groups capable of being chromed, and process of dyeing therewith.* O. Imray, London. From Soc. of Chem. Ind. in Basle, Switzerland. Eng. Pat. 15,456, Nov. 2, 1915.

NEW chromium compounds of o-hydroxy-diazo-compounds are obtained by boiling an aqueous solution or suspension of an o-amino-phenol or -naphthol derivative with chromium oxide or a salt thereof, and diazotising the chromium compound obtained; on coupling the product with a dyestuff component, chromium compounds of o-hydroxyazo dyestuffs ("half-chrome" compounds) are obtained which yield fast tints on animal fibres from an acid bath on after-chroming, or may first be treated with chromium oxide or a salt thereof to saturate with chromium all

groups capable of being chromed. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 26,460 of 1912; this J., 1913, 905.)—F. W. A.

Wool dyestuffs; Brown ——. M. Becke and W. Suida, Vienna, Assignors to Farbw. vorm. Meister, Lucius, und Brüning, Höchst, Germany. U.S. Pat. 1,196,422, Aug. 29, 1916. Date of appl., July 8, 1916.

BROWN dyestuffs for wool are obtained by the action of *p*-phenylenediaminesulphonic acid on benzoquinone or a halogen derivative thereof. Dyeings of great fastness to washing and to light are obtained; the fastness is increased by subsequent treatment with chromates or copper salts. *Examples:* (A) 123 parts of chloranil, 188 parts of 1.4-diaminobenzenesulphonic acid, and 272 parts of sodium acetate crystals are ground intimately for about 24 hrs.; (B) 54 parts of benzoquinone, 188 parts of 1.4-diaminobenzenesulphonic acid, 98 parts of sodium bichromate, and 95 parts of sodium carbonate crystals are ground together.—F. W. A.

Colour-lakes fast to light. E. Meckbach, Cologne, Germany, Assignor to Synthetic Patents Co., New York. U.S. Pat. 1,203,642, Nov. 7, 1916. Date of appl., May 14, 1915.

LAKES of great fastness to light and purity of colour are claimed containing in combination, a basic dye, *e.g.*, an alkylated dehydrothiotoluidine, aluminium, and either a polyhydroxyanthraquinone colouring matter, an aminoanthraquinonesulphonic acid, or an aminohydroxyanthraquinonesulphonic acid.—F. W. A.

Nitrosamines of primary aromatic amines; Manufacture of alkali salts of ——. A. G. Bloxam, London. From Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. Eng. Pat. 15,884, Nov. 10, 1915.

SEE Ger. Pat. 292,118 of 1915; this J., 1916, 1151.

[Anthracene] vat dyes; Producing ——. O. Bally and R. Metzger, Mannheim, Assignors to Badische Anilin und Soda Fabr., Ludwigshafen, Germany. U.S. Pat. 1,204,639, Nov. 14, 1916. Date of appl., Dec. 4, 1913.

SEE Eng. Pat. 5248 of 1913; this J., 1914, 194.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Paper-making materials; Restrictions on imports of ——.

THE President of the Board of Trade has informed the Paper Commission that the Government have decided that the imports of paper materials must, from 1st January next, be placed on the same footing as the imports of paper, that is to say, the imports of paper-making materials must be reduced by one-half instead of one-third as at present. The licences issued by the Commission for importation in respect of the supply already allowed for the two months January and February, 1917, will be reduced accordingly (see this J., 1916, 280).

PATENTS.

Threads [artificial silk]; Apparatus for making ——. C. S. Althouse, Reading, Pa. U.S. Pat. 1,202,766, Oct. 31, 1916. Date of appl., July 10, 1914.

THREADS are produced from cellulose solutions in an apparatus consisting of a reservoir from which the solution flows through a centrifugal separator which cleanses it without interrupting the flow. The solution then passes to a nozzle from which it issues in filaments and falls into a coagulating liquid contained in a funnel, the stem of which is provided with means regulating the discharge of the liquid. A second funnel, placed below the first, receives the filaments and coagulating liquid, and has an outlet of greater capacity than the first, so that a pulling effect is produced on the thread as it passes through with the coagulating liquid.—F. SP.

Cellulose esters; Process for the manufacture of ——. F. Collischonn, Frankfort, and F. Ruppert, Mainz-Mombach, Assignors to Ver. für Chem. Industrie in Mainz, Germany. U.S. Pat. 1,201,260, Oct. 17, 1916. Date of appl., Aug. 29, 1913.

CELLULOSE esters (particularly cellulose acetate) insoluble in acetone, are converted into esters soluble in acetone, by heating them to 90°—110° C. in a solution containing water but no other substance having a hydrolytic action on cellulose esters, until a sample dissolves to a clear solution in acetone, but not in ethyl acetate.—F. SP.

Acetylcellulose plastic compounds; Process of making ——. W. J. Lindsay, Caldwell, N.J., Assignor to The Celluloid Co., New York. U.S. Pat. 1,203,756, Nov. 7, 1916. Date of appl., June 8, 1915.

PLASTIC compositions are made from acetone-soluble acetylcellulose by mixing it with *p*-ethyltoluene-sulphonamide, with or without triphenyl phosphate, adding a mixture of ethyl acetate and methyl alcohol, allowing the excess of solvent to evaporate, and working the mass in the usual way.—F. SP.

Paper-making process. D. Kelleher, Assignor to Hind and Dauch Paper Co., Sandusky, Ohio. U.S. Pat. 1,203,008, Oct. 31, 1916. Date of appl., July 10, 1916.

A SCREEN surface is immersed in a body of pulp solution, and suction is applied to one side of the screen over a narrow area while the other side only is in contact with the pulp; the narrow suction area is shifted relatively to the screen and the pulp solution in a direction at right angles to the length of the suction area, so that the suction acts on portions of the screen successively; the shifting of the suction area is repeated successively so long as the screen is in contact with the pulp solution, and the action of the suction may be continued while varying the depth of immersion of the screen in the pulp. Lastly the screen is removed with the deposited pulp and the latter is subjected on the screen to the action of air for drying.—J. F. B.

Paper containers; Stock for —— *and process of producing same. Moisture-proof paper-stock and method of producing.* C. A. Bickett, Cincinnati, Ohio. U.S. Pats. (A) 1,203,302 and (B) 1,203,303, Oct. 31, 1916. Dates of appl., (A) June 14, 1913, and (B) Apr. 1, 1915.

(A) STOCK for making paper containing vessels is prepared by uniting two sheets of paper by means of an adhesive which is immiscible with the waterproof material applied to the exposed surface of one of the sheets, so that the proofing material is prevented from penetrating to any considerable depth in the thickness of the proofed sheet. The proofing material may be applied only to portions of the treated sheet, the remaining portions being left free for the application of an adhesive. (B) The stock consists of a plane-faced sheet of paper coated on one face with a fluid, moisture-proof material, such as paraffin, except on those portions where it is desired subsequently to apply printing or an adhesive for forming the containers, in such a manner that the paraffin does not penetrate to the opposite face of the sheet. —J. F. B.

Pulp for paper and the like; Process of producing ——. R. B. Embree, Kingsport, Tenn. U.S. Pat. 1,203,511, Oct. 31, 1916. Date of appl., June 3, 1916.

Wood is shredded by separation of its fibres lengthwise until reduced to portions sufficiently small to be readily soaked. The shredded wood, thoroughly moistened, is rubbed between stones to reduce it to fibrous strands in suitable condition for pulping; the material is treated with a solution to neutralise tannic acid without reducing the binding matter and finally converted into a pulp for the production of coarse paper.—J. F. B.

Rosin [paper] sizing composition. J. A. De Cew, Montreal. U.S. Pat. 1,203,857, Nov. 7, 1916. Date of appl., Oct. 12, 1914.

Approximately 1% of a rubber product is dissolved in an alkali resinate.—J. F. B.

Waterproofing composition [for fabrics]; Non-inflammable ——. J. O. Persons, Norfolk, Va. U.S. Pat. 1,204,056, Nov. 7, 1916. Date of appl., Apr. 26, 1915.

Carbon tetrachloride is added to a solution of rubber cement in quantity at least equal to that of the rubber-solvent employed, to make it non-inflammable. Suitable proportions are: rubber cement, 10—15; spirits of turpentine, 4·5—7; paraffin wax, 2—4; gasoline, 20—40; carbon tetrachloride, 40—75 parts.—J. F. B.

Sulphite liquor; Process of making an adhesive from waste ——. J. A. De Cew, Montreal. U.S. Pat. 1,203,856, Nov. 7, 1916. Date of appl., Feb. 17, 1913.

Waste sulphite wood-pulp liquor is concentrated *in vacuo* with an excess of magnesium oxide, and magnesium chloride is added to the product in proportion equivalent to the amount of magnesium oxide remaining in excess, to form magnesium oxychloride.—J. F. B.

Dyeing leather, silk, cotton, wood, and paper, and preparation of water-, oil-, and lake-colours. Ger. Pat. 294,572. *See* VI.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Bleaching processes for thick, full-bleached cotton; Experiments with various ——. M. Freiberger. Z. angew. Chem., 1916, 29, 397—400.

Cold- or warm-bleached cotton, especially the former, in case it has not been soured, tends to become yellow. Even if a satisfactory white has been produced by cold bleaching and subsequent souring, its keeping qualities are unsatisfactory. A very pure white was obtained with warm hypochlorite solution without the materials showing any tendency to turn yellow. Over-bleaching, whether it was caused by an increase in the active chlorine of the bleach solution or by raising the temperature of the bath or the duration of its action, destroyed the white and its stability. Warm over-bleaching is not so deleterious as cold. It is better to increase the time of action of the bleaching solution then to raise its temperature above a certain limit. Souring improves the white produced by alkaline bleaching and its stability, although cotton so treated takes up more Methylene Blue then unsoured material. From this it follows that the affinity of the Methylene Blue mordants for the basic dyestuff afford no correct measure of the tendency of soured or unsoured materials to turn yellow. Much better results are obtained by using a hypochlorous acid bath at a higher temperature. The amount of Methylene Blue mordants produced in acid bleaching are not related to the stability of the white in the same manner as in the hypochlorite treatment; the more Methylene Blue mordants are present in the material treated with hypochlorite, the more it tends to become yellow, whereas the Methylene Blue mordants formed in acid bleaching only lead to yellowing in a less degree, if at all, and the amounts of these mordants in the finished material are not directly proportional to the stability of the white. It is possible that not only the substances not removed by bowking or destroyed by hypochlorite, but also those produced by warm alkaline bleaching as well as the Methylene Blue mordants are converted into substances which do not tend to become yellow. The action of hypochlorous acid improves even material bleached with warm hypochlorite solution, and undoubtedly the best process is to treat fabric with warm hypochlorite and then with an acid bleaching bath, when a pure white of satisfactory stability is obtained. Comparison of two white bleached materials of apparently equal value showed that the sample which had been treated in a cold alkaline bleaching bath and subsequently soured became four times as dark on storing and steaming and twice as dark with Methylene Blue as the sample treated in a warm alkaline and then in a warm acid bleaching bath.—F. W. A.

Patents.

Proofing canvas and like textile fabrics; Process for ——. J. Inglis, Dundee. Eng. Pat. 101,894, Jan. 13, 1916 (Appl. No. 573 of 1916), and June 14, 1916 (Appl. No. 8403 of 1916).

Colour shades of regular or irregular character are produced by proofing canvas and like textile fabrics with two solutions of "cupra-ammonia," to one of which is added an inorganic agent, *e.g.*, a chromate, and to the other an organic agent, *e.g.*, gallic or tannic acid. The two solutions may be applied separately or after admixture.
—F. W. A.

Waterproofing fibrous materials; Process of —— and product. W. W. Carter, Needham, Assignor to The Newton Co., Newton, Mass. U.S. Pat. 1,202,803, Oct. 31, 1916. Date of appl., Oct. 22, 1914.

Fibrous materials are waterproofed by impregnating with a molten insoluble soap mixture containing a soap possessing tough and elastic properties when solid and another soap introducing qualities of softness and flexibility, and allowing the soap to solidify in the fibres. A molten mixture of one part of the lead soap of oleic acid to nearly two parts of Chinese wood oil soap is specially claimed.—F. W. A.

Dyeing hairs, furs, etc.; Process for ——. Farbw. vorm. Meister, Lucius, u. Brüning. Ger. Pat. 294,184, July 9, 1915.

The material is treated with a solution of a triaminodiphenylamine or a homologue thereof or of a corresponding sulphonic acid, with or without an oxidising agent. Suitable triaminodiphenylamines are obtained by condensation of phenylene- or toluylenediamines or their sulphonic acids with chlorodinitrobenzene, and subsequent reduction.
—A. S.

Dyeing leather, silk, cotton, wood, and paper, and preparation of water-, oil-, and lake-colours. F. Fresenius and A. Zimmer. Ger. Pat. 294,572, Dec. 24, 1914. Addition to Ger. Pats. 291,138 and 293,232 (this J., 1916, 834, 1057).

The use of ammonium, potassium, or sodium molybdate, together with aromatic hydroxy or amino compounds, with or without addition of metallic salts, for dyeing leather, silk, cotton, wood, and paper, and for the preparation of water-, oil-, and lake-colours, is claimed.—A. S.

Wool-like effects on cotton fabrics; Production of ——. Heberlein und Co., Wattwill, Switzerland. Ger. Pat. 294,571, July 18, 1914. Addition to Ger. Pat. 290,444 (see Fr. Pat. 468,821 of 1914; this J., 1914, 959).

THE material is treated with sulphuric acid of 49°—51° B. (sp.gr. 1·514 to 1·546), washed, mercerised without tension, and again washed. —A. S.

Printing fabrics with colours which "run" or "bleed." W. Roessingh, Veenendaal, Holland. Ger. Pat. 294,666, June 16, 1914.

THE printing paste contains a dyestuff or dyestuffs, an alkali or alkaline substance, and a reducing substance capable of converting the dyestuffs into leuco-compounds, and in addition a developer, *i.e.*, a substance or substances capable of combining with diazo compounds in alkaline solution to form insoluble azo dyestuffs. This paste is printed on the fabric, which, if necessary, may be first soaked in water or in a dilute solution of a thickening agent; the printed material is steamed to produce the leuco-compounds, then passed through a slop padding machine to cause the developer to "run" or "bleed," and afterwards through a diazo solution.—A. S.

Manufacture of chromium compounds of azo dyestuffs containing groups capable of being chromed, and process of dyeing therewith. Eng. Pat. 15,456. *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Bleaching powder supplies. Committee appointed.

THE Ministry of Munitions has appointed a representative Committee, called the Bleaching Powder Users Committee, under the chairmanship of Colonel Alan Sykes, M.P., to advise and consult with the Munitions Department as to the needs of the users of bleaching powder. All users of bleaching powder who are experiencing difficulties in obtaining their supplies are requested to communicate with the Secretary of the Committee at 4, Norfolk Street, Manchester.

Waste lyes from the potash industry; Removal of sulphates from ——. H. Hof. Chem.-Zeit., 1916, 40, 893.

IT is pointed out that the process claimed in Ger. Pat. 270,620 of 1912 (this J., 1914, 422) for the removal of sulphates from the waste lyes by means of calcium chloride has been previously investigated by Schwarz (Dingl. Polyt. J., 1876, 219, 345—360), who proved that the precipitate obtained when magnesium chloride is present consists of gypsum, not syngenite ($K_2SO_4,CaSO_4,H_2O$). By agitating waste lyes containing potassium and magnesium sulphates with finely powdered anhydrous calcium sulphate, some syngenite was formed, but even after 24 hours only about one-half of the soluble sulphate had been precipitated.—W. R. S.

Oxidising agents; Potential changes on illumination of ——. T. Swensson. Z. physik. Chem., 1916, 91, 624—636. J. Chem. Soc., 1916, 110, ii., 548.

THE author has studied the influence of ultraviolet light on the oxidation potential of a solution of potassium bichromate and sulphuric acid. Solutions of potassium bichromate and sulphuric acid were placed in quartz vessels and the potential measured against a platinum electrode in the usual way. The solution was then subjected to the light from a mercury lamp, and the potential again measured after the light had been removed. The potential rapidly rises when the solution is illuminated, and on removing the light it slowly falls again. The same effects are observed whether the platinum electrode is present in the solution when it is illuminated or not. The cause of the large change in potential is in some way due to a mutual action of the bichromate and sulphuric acid, since both potassium bichromate solution and sulphuric acid when submitted alone to the action of the light only give a lowering of the potential, whereas chromic acid solution gives a slight increase. Experiments with $N/1$-, $N/2$- and $N/3$-solutions show that the increase of potential is independent of the concentration. In the case of a solution of 1 mol. of potassium bichromate and 4 mols. of sulphuric acid per litre, the increase in the potential by illumination is 0·2280 volt.

Mercury salts; Volumetric determination of ——. *Evaluation of mercuric chloride compresses.* G. Adanti. Boll. Chim. Farm., 1916, 55, 553—554. J. Chem. Soc., 1916, 110, ii., 579—580.

THE method is based on the reduction of mercury salts to metallic mercury by means of formaldehyde in presence of potassium hydroxide. The mercury is treated with excess of a standard iodine solution, the excess of the latter over the amount required to convert the mercury into mercuric iodide being determined by titration with standard sodium thiosulphate solution. The method is rapid and gives very exact results, and is carried out as follows. One gram of the mercuric salt or of the mercuric chloride compress is treated with a little water and, if necessary, sodium chloride to dissolve the mercuric salt, the solution being made up to 250 c.c. Fifty c.c. of the liquid is mixed in a beaker with 5 c.c. of formalin (about 40% aqueous formaldehyde solution) and 10 c.c. of 33% sodium or potassium hydroxide solution, and the whole heated on a water-bath for a few minutes and then allowed to cool. The liquid is now neutralised with acetic acid and the precipitated mercury collected and washed. Filter and precipitate are shaken with 100 c.c. of water slightly acidified with acetic acid and exactly 20 c.c. of $N/10$ iodine solution until all the mercury has passed into solution as mercuric iodide, and the excess of iodine is estimated; 1 c.c. of $N/10$-iodine = 0·01 grm. of mercury or 0·01355 grm. of mercuric chloride.

Lead arsenates. Equilibrium in the system PbO, As_2O_5, H_2O. C. C. McDonnell and C. M. Smith. J. Amer. Chem. Soc., 1916, 38, 2366—2369. (See also this J., 1916, 1154.)

THE three-component system PbO,As_2O_5, and H_2O can be easily investigated as far as mono- and di-lead arsenates are concerned, but the system as such cannot be followed beyond di-lead arsenate owing to the insolubility of lead hydroxide. Ammonia seemed particularly suitable as a base to produce the desired alkalinity. The use of ammonia in such a system introduces a fourth component, but by keeping its concentration constant, the system will behave like a three-component one. The results obtained are given in a table and graph. They show that the action of dilute ammonia on di-lead ortho-arsenate proceeds as follows:—(1) Transposition to tri-lead ortho-arsenate, the supernatant solution* remaining constant at the $(NH_4)_2HAsO_4$ stage until transformation is complete. (2) Formation of solid solutions ranging from tri-lead arsenate to a basic arsenate (molecular ratio PbO,As_2O_5 = 3·253), beyond which no further change occurs. About 100 grms. of tri-lead arsenate was prepared by treating di-lead arsenate with the theoretical amount of $N/10$ ammonia, as calculated from the data given. The product contained a small amount of water not expelled at 110° C. It is

an amorphous powder with a sp.gr. of 7·00 at 15°/4° C. Crystallised tri-lead arsenate (anhydrous) prepared by fusion had a sp.gr. of 7·30 at 15°/4° C.—T. H. B.

Vanadic acid; Reduction of —— by hydriodic acid. G. Edgar. J. Amer. Chem. Soc., 1916, **38**, 2369—2377.

According to Ditz and Bardach (Z. anorg. Chem., 1915, **93**, 97) the reduction of vanadic acid by hydriodic acid at the ordinary temperature proceeds irregularly, but the amount of iodine liberated corresponds approximately to the reduction of quinquevalent to trivalent vanadium. Their results were, however, probably vitiated by the effects of atmospheric oxidation, for on allowing the reaction to take place in an atmosphere of hydrogen, the author found that reduction to the quadrivalent condition is quantitative even when the concentration of acid is three times and that of iodide four times that used by Ditz and Bardach. The mechanism of the reaction between vanadic acid and the halogen acids, and the influence of various factors upon the equilibrium is discussed, and it is considered that the conflicting results of different investigators are due to neglect to take into consideration the effect on the reaction of the concentration of the halogen ion, the concentration of the VO^{+++} ion, the discharging potential of the halogen ion, and removal of the liberated halogen from the solution (usually by boiling, evaporation, extraction, or by reaction with a metal).—T. H. B.

Tungsten derivatives; Analysis of certain ——. O. R. Sweeney. J. Amer. Chem. Soc., 1916, **38**, 2377—2383.

Peculiar difficulties are met with in the analysis of "complex inorganic acids," particularly in connection with the separation of phosphoric and vanadic acids from molybdic and tungstic acids. It was found that in presence of a tungstate arsenic is expelled only with great difficulty from an arsenate even when heated in a stream of dry hydrogen chloride. By heating at a temperature a few degrees below that at which volatilisation of tungstic acid takes place, however, all the arsenic can be removed. An antimonio-tungstate when treated in a similar manner, also gave concordant results. When dry hydrogen chloride was passed over a sodium vanadio-tungstate the vanadium volatilised as a red vapour condensing to a reddish-brown liquid (the oxychloride). The residue was, however, soon reduced to a brownish mass, no longer attacked, but by introducing chlorine gas along with the hydrogen chloride the vanadic acid was rapidly and completely expelled. The appearance of the red vanadium oxychloride proved a delicate test for vanadium. When this no longer showed, it was always found that the vanadic acid had been completely expelled. For estimating the vanadium after volatilisation, the volumetric method using potassium permanganate was found best suited to the conditions of the experiments. It was proved that no loss occurred on evaporating a strong hydrochloric acid solution of vanadium.—T. H. B.

Tungsten; New derivatives of ——. J. B. Hill. J. Amer. Chem. Soc., 1916, **38**, 2383—2391.

The action of chlorine on tungsten metal to form the hexachloride is catalysed to a remarkable degree by the presence of a small amount of platinum black. In presence of the latter 20 grms. of pure tungsten was converted into the hexachloride in 1½—1¾ hours, whereas in absence of platinum, seven hours was required to convert 10 grms. of tungsten. By the action of sodium-amalgam on the hexachloride the author obtained the compound, $W_6Cl_{12},2HCl,9H_2O$, resembling the molybdenum derivative, $Mo_3Cl_6,HCl,4H_2O$ prepared by Rosenheim and Kohn (Z. anorg. Chem., 1910, **66**, 1). The alkaline solution of this compound oxidises readily and from the solution, stable hydrates of trivalent and quadrivalent tungsten were obtained.—T. H. B.

Yttrium; Purification and atomic weight of ——. B. S. Hopkins and C. W. Balke. J. Amer. Chem. Soc., 1916, **38**, 2332—2347.

The ignition of the sulphate to oxide is not a satisfactory method for determining the atomic weight of yttrium, since the result may vary widely according to length of time and temperature of ignition; the anhydrous sulphates are extremely hygroscopic, and there is uncertainty in regard to the complete expulsion of the sulphuric acid. In preparing pure yttria the three methods of purification may be summarised thus: (a) Fractional precipitation with potassium chromate is effective for removing considerable quantities of other rare earths from yttrium, but will not remove all the erbium or holmium. (b) Fractional precipitation with dilute ammonia solution is tedious, and does not produce pure yttria. (c) Fractionation with sodium nitrite is both a rapid and effective means of freeing yttrium material from admixtures of erbium and holmium. The hydrates $Y_2(SO_4)_3,8H_2O$ and $YCl_3,6H_2O$ were found to be too variable for use in atomic weight determination. The atomic weight of yttrium was determined by the ratio $Y_2O_3:2YCl_3$, using material from six different fractions. The average of the values obtained is 88·9.—T. H. B.

Conductivity water; Preparation of ——. J. Kendall. J. Amer. Chem. Soc., 1916, **38**, 2460–2466.

One distillation of tap water from various sources, after addition of a few c.c. of Nessler reagent, using Jena glass vessels and a block tin condenser, yielded water of specific conductivity $0·9\times10^{-6}$ at 25° C. By redistilling in silica vessels water of specific conductivity 0·2 to $0·6\times10^{-6}$ at 25° C. was obtained, but on standing the conductivity rapidly increased to and remained constant at 0·8 to $0·9\times10^{-6}$ at 25° C., the specific conductivity of a saturated solution of carbonic acid under atmospheric conditions (see this J., 1916, 269). A lower permanent specific conductivity for water than 0·8 to $0·9\times10^{-6}$ at 25° C. cannot be obtained unless strict precautions are taken to prevent access of air. It is suggested that in preparing water for conductivity experiments the aim should be to exclude all impurities other than carbonic acid, an exact correction being made for the latter.—T. C.

Graphites; Oxidation products of various ——. A. Lang. Montan. Rundschau, 1916, **19**, 1—3. J. Chem. Soc., 1916, 110, ii., 561.

The use of molten alkali for the purification of graphite is liable to cause changes in its constitution, and hydrochloric and hydrofluoric acids, etc., are to be preferred for the purpose. Oxidation of graphite by means of permanganic acid gives graphitic acids of variable composition, and more uniform results are obtained with a mixture of concentrated sulphuric and nitric acids and potassium chlorate. There are two graphitic acids occurring in leaflets, distinguishable from one another in colour and composition. The graphitic acids from Acheson, Ceylon, and Russian blast-furnace graphite are yellow, whilst those from Siberian, Italian, Corean, and cast-iron graphite are green, the former being richer in carbon and poorer in oxygen than the latter. Artificial, non-intumescent graphites give graphitic acids of approximately the same composition as the intumescent natural variety. Cast-iron graphite, however, forms an exception, as it approximates in its behaviour to the natural non-intumescent

varieties. The colour of the graphitic acids diminishes in intensity in the light. Prolonged washing transforms them into a colloidal modification, whilst on further oxidation or long-continued heating at 120°—130° C. they assume a darker, earthy-brown colour. In both cases disintegrative oxidation occurs.

Carbon and nitrogen; Combination of —— at the ordinary temperature. A. P. Lidov. pp. 4. Charkov, 1916.

IN presence of catalytic iron, the interaction of carbon and air (freed from carbon dioxide) in the cold consists first in the gasification of the solid carbon with formation of the simplest nitrogen-carbon compounds, namely, active α- and inert β-monocyanogen. The oxygen of the air does not take part in the initial stage of the process; this result agrees with those of the author's earlier experiments with pure oxygen in the cold, which showed that under such conditions carbon does not undergo the slightest gasification. In the second phase of the process, the α-monocyanogen is oxidised to the stable α-oxan, OCN, and possibly to peroxan, O_2CN.—T. H. P.

Carbon; Oxidation of —— by air at low temperatures in presence of iron and other metals. A. P. Lidov. Reprint. pp. 11. Charkov, 1916.

EXPERIMENTS have been made on the oxidation of finely divided carbon in the air at low temperatures in presence of lead, nickel, iron, and other metals. Charcoal activated with lead does not lose its activity for a very long time, whereas that activated with nickel or iron loses it rapidly, probably because the metal precipitated on the surface of the charcoal undergoes conversion into its higher oxide. The specific gravity of the gas giving a precipitate in barium hydroxide solution and obtained by the oxidation of carbon activated by means of lead is always less than that obtained from carbon activated with nickel or iron and is, on the average, very near to the specific gravity of oxan.—T. H. P.

Natural limestones; Carbon dioxide from ——. A. P. Lidov. pp. 35. Charkov, 1916.

A NUMBER of samples of calcspar, aragonite, friable limestones such as chalk, dense limestones such as marble, etc., have been decomposed with acid and the specific gravity of the evolved gas measured. Variable results were obtained, the values for the gas from calcite being exceptionally low. In explanation of this phenomenon, it is suggested that many limestones contain a more or less considerable proportion of α-oxan, OCN, in addition to the combined carbon dioxide; owing to its ease of formation, α-oxan may exist in wide distribution.—T. H. P.

Colloidal iodine. H. Bordier and G. Roy. Comptes rend., 1916, **163**, 567—569. (See this J., 1916, 962 and 1058.)

IODINE, dissolved in pure water, is in the colloidal state, but is in the form of "amicrons" too small to be seen by the ultramicroscope. The presence of gelatin, in suitable proportions, has the effect of facilitating the union of the amicrons into larger particles visible in the ultra-microscope. By submitting the pseudo-solution of iodine in gelatin to a potential difference of 62 volts, the particles are displaced towards the positive electrode and are therefore charged negatively; the discharge of most of the particles is complete and the iodine resumes its crystalline form. In the presence of a small quantity of sodium thiosulphate, however, the discharge is not completed, although the particles are displaced towards the positive electrode, but a deep red-brown coagulum is formed showing masses of agglomerated granules without any appearance of crystalline form.—B. N.

Separation of lithium from other alkali metals. Palkin. *See* XXIII.

PATENTS.

(A) *Sulphuric acid; Process of making —— and catalyser therefor.* (B) *Process of making sulphuric anhydride.* (C) *Contact material.* (A) and (B). C. Ellis, Montclair, N.J., (C) C. Ellis, Montclair, and H. M. Weber, East Orange, N.J., Assignors to Ellis-Foster Co. U.S. Pats. 1,204,141, 1,204,142, and 1,204,143, Nov. 7, 1916. Dates of appl., (A) Jan. 29, 1916, (B) Dec. 6, 1915, (C) Dec. 17, 1915.

(A) IN the manufacture of sulphur trioxide by passing sulphur dioxide and oxygen over a catalyst, the catalyst consists of an intimate mixture of active voluminous chromium oxide and an oxy-compound of an easily fusible heavy metal, which is capable of absorbing sulphur dioxide and acts as binding agent for the chromium oxide but does not combine with it. (B) The catalyst consists of a mixture of voluminous chromium oxide and tin oxide, one of them being in excess of the amount required for the production of tin chromate, and one of the oxides being catalytically active. (C) The catalyst consists of a porous mixture of chromium oxide and an activating agent; this may be obtained for example by heating together a mixture of ammonium bichromate and tin chloride, or a mixture of chromium and tin oxides with an organic substance.—B.V.S.

Nitrous gases; Process of converting —— into concentrated nitric acid. O. Jensen, Rjukan, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,197,295, Sept. 5, 1916. Date of appl., May 27, 1916.

NITROSULPHONIC acid, obtained by absorbing nitrous gases in concentrated sulphuric acid, is denitrated by passing it down a tower containing acid-resisting material, where it meets dilute (60%) nitric acid vapour and air (or oxygen) entering at the base. By condensing the vapours leaving the tower, red fuming nitric acid is obtained, and this is decolorised by blowing air through it. The nitrous gases so liberated, together with the uncondensed vapours from the denitrating process, are passed into water, and the dilute nitric acid obtained is used for further denitration. In this way concentrated nitric acid is produced directly from nitrosulphonic acid, and the resulting sulphuric acid is of about 80% strength, so that it requires but little further concentration to make it available for absorbing fresh quantities of nitrous gases.—E. H. T.

Hydrochloric acid, sodium sulphate, and magnesium sulphate; Process of obtaining ——. W. C. Kerr, Catonsville, Ind. U.S. Pat. 1,203,357, Oct 31, 1916. Date of appl., Apr. 4, 1914.

A MIXTURE of nitre cake and magnesium chloride, in the proportion of two molecules of the former and one of the latter, is heated with a little water, to about 200° C. Hydrochloric acid is evolved and a mixture of sodium and magnesium sulphates remains.—B. V. S.

Zinc sulphate; Manufacture of ——. Metals Recovery, Ltd., and R. W. E. MacIvor, Westminster. Eng. Pat. 12,799, Sept. 7, 1915.

ORES containing zinc and lead sulphides and admixed iron are ground in presence of concentrated zinc sulphate liquors, and separated into fine sands and slimes. The ferruginous sands are roasted to convert the zinc into sulphate, and it the iron content be low, ferric oxide, obtained preferably from the residue of a previous roast, is added to the charge, to accelerate the oxidation of sulphur dioxide to the trioxide, thereby increasing the yield of zinc sulphate. The roasted

and partially cooled material is extracted with dilute sulphuric acid in a leaching tank or rotating barrel, whereby both basic zinc sulphate and zinc oxide go into solution. The iron in the leach liquor may be removed by treatment with zinc oxide and injecting heated air; the precipitated ferric hydroxide helps to bind the residual lead ore and to improve it for subsequent treatment in the blast furnace. If much iron be present in the ore, an excess of acid is used for leaching, the iron in the solution is oxidised to the ferric state, and unroasted slimes are added and well stirred in: $Fe_2(SO_4)_3+ZnS=2FeSO_4+ZnSO_4+S$. This action is carried out under an excess pressure of ½—1 atmosphere and in presence of an excess of zinc sulphide. The zinc sulphate liquor may be evaporated and the residue roasted and extracted with dilute acid to eliminate the iron; or it may be treated with more acid, evaporated to yield mono- or di-hydrated zinc sulphate, the mother liquor rich in iron being used for treating raw slimes; or it may be purified from iron by the action of the zinc oxide contained in the sulphated roast.—E. H. T.

Sodium perborate; Electrolytic production of ——. Deutsche Gold- und Silber-Scheidenanstalt, vorm. Roessler, Frankfort, Germany. Eng. Pat. 100,152, Mar. 1, 1916. Under Int. Conv., Mar. 10, 1915. (Appl. No. 3804 of 1916.)

In the electrolytic production of sodium perborate the cathode may be composed of substances such as lead, iron, nickel, copper, or carbon which, *per se* or as compounds, have a decomposing action on the perborate. Except in the case of nickel, it is necessary to protect the cathode at the surface of the liquid by a coating such as platinum or varnish, or by a rubber sleeve.—B. V. S.

Sodium and potassium salts; Separation of ——. H. P. Bassett, Catonsville, Assignor to The Spar Chemical Co., Baltimore, Md. U.S. Pat. 1,194,465, Aug. 15, 1916. Date of appl., Mar. 8, 1915. (See also this J., 1914, 484.)

To a solution containing, *e.g.*, 90 pts. of sodium sulphate and 10 pts. of potassium sulphate, sodium chloride is added in equimolecular proportion to the potassium salt, and the liquid is evaporated until sufficient sodium sulphate has separated to leave an amount of potassium chloride in solution equal to 40% of the total dissolved salts. The mother liquor is then treated with sodium nitrate (in amount equimolecular to the potassium chloride), and the solution is evaporated, whereby sodium chloride and sulphate crystallise out from the hot liquid; and these are used for the treatment of a new batch of the mixed sulphates. The potassium nitrate left in the mother liquor is crystallised out, leaving sodium chloride, sodium nitrate, and about 15% of potassium nitrate in solution; it is separated, re-dissolved in water, added to the original solution of mixed sulphates (so that equimolecular proportions of sodium sulphate and potassium nitrate are present), and on evaporating, potassium sulphate crystallises, which is removed and washed with hot water. The wash water, containing chiefly sodium nitrate, together with the mother liquor from the potassium nitrate crystallisation, is added to the solution containing 40% of potassium chloride, instead of fresh sodium nitrate. The reagents are thus used over and over again, the only materials separated being sodium sulphate from the first evaporation and potassium sulphate from the last.—E. H. T.

Alumina; Crystalline fused —— and the manufacture thereof. F. J. Tone, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,192,709, July 25, 1916. Date of appl., Dec. 1, 1914.

A charge of aluminous ore, *e.g.*, bauxite, with or without a small proportion of carbon, is heated to a temperature several hundred degrees above its melting point, in an electric furnace, and is then run off into a shallow mould in which it quickly solidifies. The solid product is ground and consists of alumina crystals (mostly 0·01 to 0·3 mm., with an average diameter of about 0·1 mm.) and a uniformly distributed "residual basis," composed mainly of compounds of titanium, iron, and silicon, derived from impurities in the ore. It is superior to ordinary crystalline fused alumina as an abrasive.—F. Sodn.

Sulphuric acid chamber. J. Harris, Sheffield, and D. H. Thomas, Morriston, Wales. U.S. Pat. 1,203,615, Nov. 7, 1916. Date of appl., Mar. 27, 1916.

See Eng. Pat. 6026 of 1915; this J., 1915, 1249.

Nitrate of lime and similar substances; Process of granulating —— without dephlegmation and dust. A. Holter, Rjukan, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,203,740, Nov. 7, 1916. Date of appl., Jan. 6, 1914.

See Fr. Pat. 466,903 of 1914; this J., 1914, 865.

Lead oxide; Method and apparatus for producing ——. E. Barthelmess, Neuss, Germany. U.S. Pat. 1,204,537, Nov. 14, 1916. Date of appl., Apr. 25, 1914.

See Fr. Pat. 466,129 of 1913; this J., 1914, 593.

Formates; Process of making ——. G. Bredig, Karlsruhe, Assignor to R. Koepp und Co., Oestrich, Germany. U.S. Pat. 1,204,933, Nov. 14, 1916. Date of appl., Dec. 4, 1914.

See Eng. Pat. 801 of 1915; this J., 1915, 1143.

Recovery of the salts contained in the waste gases from Portland cement kilns. Ger. Pat. 294,539. *See* IX.

VIII.—GLASS; CERAMICS.

Patents.

Refractory materials; Process for making ——. C. B. Stowe, Lakewood, Ohio. U.S. Pat. 1,205,056, Nov. 14, 1916. Date of appl., Oct. 6, 1916.

A basic refractory material is made by mixing magnesium carbonate with iron oxide and water and moulding into bricks, etc., which are afterwards burned so as to expel the carbon dioxide and cause the chemical combination of the magnesia with the iron oxide, with the formation of magnesioferrite, MgO,Fe_2O_3. After once burning the material may be crushed to powder, re-made into bricks, and these burned at a still higher temperature.—A. B. S.

Refractory bricks; Manufacture of ——. T. Twynam, Redcar. Eng. Pats. 15,163, Oct. 27, and 16,237, Nov. 18, 1915.

Finely ground raw magnesite, dolomite, or limestone, or a mixture of these is mixed with half its weight of chrome iron ore, not too high in silica, and with water in a pug-mill, and then made into bricks and burned at 1600° C. The bricks shrink very slightly in burning and withstand the action of water for a long time. Equal parts of dolomite, magnesite, and chrome ore also make good, hard bricks, and other proportions may be used so long as there is not less than 20 or more than 80% of chrome ore present. The components must be very intimately mixed.—A. B. S.

Silicon carbide refractory articles. F. J. Tone, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,204,211, Nov. 7, 1916. Date of appl., May 6, 1913.

Silicon carbide in grains of various sizes between 14- and 150-mesh, so as to give an apparent

density of not less than 2·3 when pressed, is mixed with one-ninth of its weight of a binder (*e.g.*, clay) inert to the carbide and having a vitrifying temperature of at least 1500° C., so as to produce articles having, after burning, an apparent density of not less than 2·3.—A. B. S.

Casting earthenware articles; Process of making slips for ——. C. J. Kirk, New Castle, Pa. U.S. Pat. 1,203,011, Oct. 31, 1916. Date of appl., Dec. 29, 1913.

BALL clays, water, and soda salts in suitable proportions are thoroughly mixed in a blunger, and china clays, flint, and felspar are then added in the required proportions.—A. B. S.

Enamel composition. R. Rickmann, Cologne-Marienburg, Germany. U.S. Pat. 1,203,409, Oct. 31, 1916. Date of appl., Feb. 25, 1913.

A WHITE opaque enamel consisting of a difficultly soluble potassium antimoniate combined with an enamel is claimed.—A. B. S.

Crystalline fused alumina, and manufacture thereof. U.S. Pat. 1,192,709. *See* VII.

IX.—BUILDING MATERIALS.

PATENTS.

Heat insulating material; Manufacture of ——. J. Cuthbertson, London. Eng. Pat. 17,949, Dec. 23, 1915.

SHEETS of corrugated paper are rolled into a tube or piled so as to form a slab of the desired thickness and immersed (with or without pressure) in a mixture of two volumes of sodium silicate solution (75° T., sp.gr. 1·375) and one volume of graphite at 95°—100° F. (35°—38° C.). The impregnated paper is taken out, drained, dried in a stove, and then cut to the desired shapes, fitted together to form pipes, etc., and covered with canvas so as to produce waterproof joints.—A. B. S.

Concrete; Treating ——. C. Ellis, Montclair, N.J. U.S. Pat. 1,189,551, July 4, 1916. Date of appl., Oct. 17, 1911.

A COMPOSITION for waterproofing concrete and rendering it resistant to alkali is made by mixing Jelutong or Pontianak rubber resin or other unsaponifiable resin with a colloidal thickener, such as polymerised tung oil or the aluminium soap of fish oil or of Chinese wood oil, and with waxes and sulphonated oils, the whole being brought to a suitable viscosity by means of a solvent such as benzene or carbon bisulphide. For example a mixture of heat-treated Jelutong resin 25, ceresin 2, oil-soluble compound from cotton-seed oil and sulphur chloride 8, tung acids 10, Japan drier 1, benzol 30, and benzine 24 parts, may be used. Rubber may be substituted for the cotton-seed product when the material is to be applied to strongly alkaline cements, the rubber being previously dissolved in the tung oil by the aid of heat. For structural steel, a viscous material which will bond both with the steel and the concrete is needed. It may consist of heat-treated Pontianak resin 25, recovered rubber 10, wax 5, "candle tar" 5, gilsonite 5, and coal naphtha 50 parts, together with sufficient Portland cement or other filler to make a heavy bodied coating mixture. The concrete may be coated by means of a brush or spray, or small articles may be dipped in the composition. A flat coating may be produced by spraying a solution of Pontianak resin in benzol and adding one-third part of tung oil and 1/24th part of Japan drier and (if desired) 1/12th part of ceresin. For coating acid-tanks, a solution consisting of equal parts of Pontianak rubber resin and tetra- or penta-chloronaphthalene may be used. Where the concrete is liable to destruction by moulds, etc., the coating composition may contain creosote or other antiseptic material.—A. B. S.

Wood; Process of treating ——. H. M. Newton, Minneapolis, Minn. U.S. Pat. 1,203,038, Oct. 31, 1916. Date of appl., May 21, 1914.

WOOD is impregnated with a fluid preservative, such as creosote, and part of the latter is afterwards removed from the outer layer of the wood by treatment with steam and by suction, so as to prevent subsequent "bleeding."—A. B. S.

Portland cement kilns; Recovery of the salts contained in the waste gases from ——. F. Schott, Heidelberg. Ger. Pat. 294,539, Jan. 5, 1915. Addition to Ger. Pat. 291,070 (see U.S. Pat. 1,064,550; this J., 1913, 753).

ACCORDING to the chief patent the hot waste gases were cooled by passing through a boiler and a feed water preheater before passing to the filter chamber to remove the fine dust. In the present patent the interposition of a drum dryer between the preheater and the filter chamber is claimed. The temperature of the gases is thereby reduced to about 60° C., and the life of the filters is prolonged.—A. S.

Cement; Process for burning —— *in shaft kilns.* G. Polysius, Eisengiesserei und Maschinenfabr., Dessau. Ger. Pat. 294,609, June 20, 1914.

THE kiln is supported on pillars spaced apart and connected by segments fitted with vertical grate-bars. A cone is mounted to rotate either centrally or eccentrically within the space surrounded by the grating thus formed, and may also be caused to travel in such a manner that its axis traverses the surface of a cone. Below the cone is a fixed or rotary horizontal grate. The cement clinker is broken up by the rotating cone and forced out between the grate-bars.—A. S.

Organic tissue [wood]; Process of protecting —— *from the attacks of destructive organisms.* L. H. Everhart, Baltimore, Md., U.S.A. Eng. Pat. 102,100, Apr. 5, 1916. (Appl. No. 4984 of 1916.)

SEE U.S. Pat. 1,182,760 of 1916; this J., 1916, 692.

Bituminous substance [for paving]; Process of manufacturing an improved ——. C. Richardson, New York. U.S. Pat. 1,198,769, Sept. 19, 1916. Date of appl., Aug. 24, 1914.

SEE Eng. Pat. 9838 of 1915; this J., 1916, 891.

Tiles, roof-sheets, and the like; Manufacture of ——. E. R. Sutcliffe, Leigh. U.S. Pats. 1,204,085 and 1,204,086, Nov. 7, 1916. Dates of appl., Oct. 2, 1914, and Apr. 4, 1916.

SEE Eng. Pat. 22,423 of 1914; this J., 1915, 179.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Trading in war material.

IN pursuance of the powers conferred on him by Regulation 30A of the Defence of the Realm (Consolidation) Regulations, 1914, the Minister of Munitions has ordered, under date 2nd November, that the War Material to which the Regulation applies shall include War Material of the following classes and descriptions, namely:—Aluminium and alloys of aluminium, unwrought and partly wrought, including ingots, notched bars, slabs, billets, bars, rods, tubes, wire, strand, cable, plates, sheets, circles, strip. Aluminium scrap and swarf, aluminium alloy scrap and swarf, remelted aluminium scrap and remelted aluminium alloy scrap and swarf. Granulated aluminium, aluminium powder, "bronze," "flake," and "flitter."

Gases in ingots of mild steel; Distribution of the ——. P. Goerens and L. Collart. Ferrum, 1916, 13, 145—151. Z. angew. Chem., 1916, 29, Ref., 471—472.

THE authors have found that the gases present in ingots of mild steel are not uniformly distributed, a larger proportion being found in the centre of the ingot than near the outer surface; this difference is greater in Thomas steel than in Siemens-Martin steel, and appears to be due chiefly to accumulation of carbon monoxide in the interior of the ingot. A considerable proportion of the carbon monoxide in the gas extracted from steel is formed by interaction between oxide inclusions and carbon, and analysis of the extracted gas (see this J., 1916, 845) affords a valuable means of ascertaining the degree of deoxidation of the metal. The average amount of gas per c.c. of metal was found to be: Siemens-Martin steel, 6·6 c.c. (CO 4·2, CO_2 0·8, H 1·5, N 0·1 c.c.); Thomas steel, 8·0 c.c. (CO 5·2, CO_2 0·8, H 1·6, N 0·4 c.c).—A. S.

Boron: Determination of —— in boron-steel. C. Aschman, jun. Chem.-Zeit., 1916, 40, 960—961.

THE steel (1 to 3 grms.) is dissolved in dilute sulphuric acid in a flask beneath a reflux condenser, care being taken to avoid too large an excess of acid. The solution is transferred to a distillation flask, and the flask is connected with an inverted condenser, the end of which passes through a cork in a receiver containing a solution of 0·5 grm. of pure ammonium carbonate in 20 c.c. of water, with a few drops of ammonia. The outlet tube from the receiver dips into a beaker of water. The distillation flask is heated on a sand bath until nearly the whole of the liquid has distilled. The apparatus is then allowed to cool a little, 10 c.c. of absolute methyl alcohol (free from acetone) introduced, and the liquid distilled. This operation is repeated five times, a slow current of air being passed through the apparatus for some minutes after each addition of methyl alcohol, and for 15 minutes after the final distillation. The distillate is evaporated in a platinum basin containing 1 grm. of ammonium phosphate and the residue is gradually ignited in an electric oven and kept at about 1000° C. until the boron phosphate, BPO_4, becomes constant in weight.—C.A.M.

Silver; Preventing the "spitting" of ——. W. Stahl. Metall u. Erz, 1916, 13, 297—299. Z. angew. Chem., 1916, 29, Ref., 470.

WHEN silver which has been precipitated from a sulphate solution by iron, is refined, the molten metal takes up not only atmospheric oxygen but also oxygen liberated by decomposition of adhering silver sulphate, so that the tendency to "spit" on cooling is enhanced (see also this J., 1916, 601). The following method of preventing "spitting" and obtaining sound castings is recommended. After the usual melting operation, the slag is removed, the molten silver covered with a layer of wood charcoal, and the crucible closed with an iron cover. A pole of birch or alder wood is introduced through a hole in the cover. The gases (hydrocarbons, carbon monoxide, etc.) evolved deoxidise the silver and neither they nor their oxidation products dissolve in the molten metal. After some minutes, the pole and cover are removed, a further quantity of charcoal added, and the silver heated to the pouring temperature, and cast in a mould which has been coated with a mixture of oil of turpentine and rosin.—A. S.

Tank resistance in electrolytic [copper] refining; An analysis of ——. L. Addicks. Met. and Chem. Eng., 1916, 15, 566—571.

THE amount of copper recovered in electrolytic refining processes, per kilowatt-hour, is found to depend not only on current efficiency, current density, and the like, but also on the items that constitute tank resistance. This is made up of the resistance of the electrolyte, metallic conductors, contacts, slimes, etc., and counter E.M.F. and in the case of a twin tank system, an analysis of the tank resistance is given as:—electrolyte, 55·1%; metallic conductors, 16·2%; contacts, 14%; slimes, etc., 9·7%; and counter E.M.F., 5%. The conductors, carrying the current to and from the electrodes, must be made as short as possible, whilst the cross-section involves a balance between first cost, the cost of power, and sometimes strength. The cheapest cross-section is stated to be that for which the interest on the copper investment just equals the cost of the power lost by the voltage drop, the current density being usually in the neighbourhood of 500 ampères per sq. in., and a graphical method is given for determining the most economical cross-section for copper conductors. The cathode loops, it is stated, are often made so small as to have a current density far above the economical range. The contact resistances are primarily caused by adsorbed air and secondarily by oxide or other foreign matters on the contact surfaces. Loose gravity joints are stated to form one of the largest sources of waste power, and this loss may be attacked by decreasing the number of contacts, increasing the acting pressure by plugs, clamps, and by the shape of the members, and improving the condition of the surfaces by brightening, oiling being found of advantage in maintaining cleanliness whilst not interfering with the contact. The abnormal resistance to the transfer of the current between the electrodes and the electrolyte is caused by poor circulation of the electrolyte, foul anodes, etc. In general, counter E.M.F., ohmic resistance, and the screening effect of slimes have to be dealt with. The first is partly produced by insufficient circulation of electrolyte; ohmic resistance is largely produced by an adsorbed gas film on each electrode, and the addition of materials, such as gelatin, for the production of smooth deposits acts in a marked way in diminishing the resistance. A well-defined high-grade anode forms a loose granular slime offering but little resistance. The resistance of the electrolyte is regulated by the distance between the electrodes, and the composition and temperature of the electrolyte. During recent years, the better control has gradually reduced the thickness of the liquid column from 2 in. to 1·5 in. It is not customary to have more than 13% of sulphuric acid and between 2·5 and 3% of copper sulphate in the electrolyte. The liquors are usually heated to 135° F. (57° C.), and the temperature drops about 20° F. (11° C.) in passing through the system, but in modern plants generally two tanks only are placed in series and the temperature inequalities are not so marked.—B. N.

Spelter; Manufacture of pure ——. F. Juretzka. Chem.-Zeit., 1916, 40, 885—886, 891—896.

PURE spelter (99·7—99·9% Zn) is obtained from refined metal (Pb 1, Fe 0·03%) by distillation at low temperatures. Electrically heated furnaces are much more advantageous for this purpose than the ordinary gas-heated muffle furnaces, as the temperature can be closely adjusted. A central condensing system is more economical than muffles fitted with condensers, and enables the process to be carried out under reduced pressure. The yield of pure metal is 70—75%. Alloys made from pure spelter and containing zinc as principal constituent with smaller quantities of aluminium, copper, tin, or iron, are being used successfully as substitutes for copper alloys.—W. R. S.

Passive state of metals. C. W. Bennett and W. S. Burnham. Z. Elektrochem., 1916, **22**, 377—398.

THE results obtained by previous investigators, discussed in detail, are claimed to justify the view that passivity in all cases is caused by oxidation, but the existing theories are regarded as insufficient to account for the facts observed. It is submitted that the true cause of passivity is the formation of a higher oxide (compare Armstrong and Colgate, this J., 1913, 394) which is adsorbed by the metal to form a protective layer more noble than the metal itself. Very small amounts of oxide are considered sufficient to bring about passivity, and in most cases probably the oxide formed is stable only in the adsorbed state. The disappearance of passivity at high temperatures is thus accounted for by the decomposition of the oxide which accompanies diminished adsorption, and the slow change of E.M.F. as passivity develops is explained by the fact that the potential of the oxide produced has its maximum effect only when passivity is complete; other facts, such as those observed by Heathcote (this J., 1907, 899) are shown likewise to accord with the theory. When iron is rendered passive in nitric acid, it is supposed that $Fe^{\cdot\cdot}$ ions are produced and oxidised to $Fe^{\cdot\cdot\cdot}$ ions, and that then some of the $Fe^{\cdot\cdot\cdot}$ ions are further oxidised (probably to give the oxide FeO_2) and the higher oxide is adsorbed; the effect of vigorous stirring is to circulate the $Fe^{\cdot\cdot\cdot}$ ions before further oxidation can take place, and the metal therefore remains active. The protective oxide in the case of chromium is not higher than the trioxide CrO_3, for the metal becomes passive in a solution of chromic acid; it is probably the dioxide CrO_2. Lead was rendered passive without the appearance of a visible oxide film, but it is thought that the process is essentially similar whether an obvious coating is produced or not.—F. SODN.

PATENTS.

Iron ores; Process of gravity liquid separation of ——. A. J. Moxham, Wilmington, Del. U.S. Pat. 1,203,897, Nov. 7, 1910. Date of appl., Mar. 25, 1914.

IRON ore, of a composition susceptible to alteration by heat, is calcined in an inert atmosphere without reduction, and then concentrated by means of a liquid having a sp.gr. above that of the silicious constituents of the ore and containing one or more ingredients decomposable by the reduced ore. —W. E. F. P

Solder [for aluminium, etc.] and process for making the same. E. E. P. J. P. S. J. de St. Laurent, Twickenham, and The Aluminium Solder Co., Ltd., London. Eng. Pat. 13,856, Sept. 29, 1915.

THE grades of solder specified are: "hard," consisting of Zn 6·9, Sn 2·5, Al 0·6; "medium," Sn 2, Zn 5; and "soft." Sn 2, Pb 1, Zn 5 parts by weight. The metals are melted separately and then mixed together, the operations being conducted in covered graphite crucibles lined with a mixture of alumina and charcoal in the proportions of 7 to 2.—W. E. F. P.

Electro-amalgamating machine. J. Ogden, Philadelphia, Pa. U.S. Pat. 1,202,006, Oct. 17, 1916. Date of appl., Mar. 14, 1916.

A CONICAL cathode is contained in the lower part of an electrolytic tank, and a series of rotary anodes are mounted, on a shaft, above the cathode. The anode plates are secured at an angle to the shaft, so as to intercept material passing in a downward direction, and some of the anodes are formed of a portion substantially parallel with, and adapted to prevent accumulation of material on, the surface of the cathode. Means are provided for returning the pulp from the bottom of the tank to the top, and for circulating the ore solution between the anodes and cathode.—B. N.

Tungsten; [Electrolytic] production of metallic ——. F. G. Keyes and R. B. Brownlee, Assignors to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pats. (A) 1,202,534 and (B) 1,202,535, Oct. 24, 1916. Dates of appl., (A) July 6, 1914, and (B) Apr. 10, 1915.

(A) TUNGSTEN trioxide is heated to approximately 2000° C. to produce an electrically conductive lower oxide or mixture of oxides, and this is then rendered fluid and maintained in this condition by heat produced by the Joule effect in an inert atmosphere. The fluid oxide is electrolysed, using a rotating cathode of pure tungsten, and a highly refractory anode consisting of a sintered rod of pure tungsten. (B) The anode is composed of a sintered mixture of tungsten powder and lower tungsten oxides cast into the form of a bar.—B. N.

Tin scrap; Detinning ——. W. J. Phelps, Baltimore, Md., Assignor to Phelps Can Co., Weirton, W. Va. U.S. Pat. 1,202,886, Oct. 31, 1916. Date of appl., June 19, 1914.

THE scrap is heated to cherry redness, in a chamber protected from free access of air, to oxidise and volatilise the tin coating without appreciably oxidising the steel base. The latter is then cooled out of contact with air.—W. E. F. P.

Metal alloy. T. B. Brix, Assignor to American Alloys Co., Newark, N.J. U.S. Pats. (A) 1,203,180 and (B) 1,203,555, Oct. 31, 1916. Dates of appl., Feb. 2, 1915, and Oct. 17, 1914.

(A) A non-ferrous alloy containing not less than 55% of nickel or metals of the nickel group, not more than 30% of chromium or metals of the chromium group, not more than 10% of silicon, and one or more metals, *e.g.*, copper, to facilitate melting and render the product homogeneous. (B) An alloy containing 60—80% of nickel or metals of the nickel group, 10—25% of chromium or metals of the chromium group, and copper and/or manganese, with or without addition of tungsten.—W. E. F. P.

Cobalt-chromium alloys. E. Haynes, Kokomo, Ind., U.S.A. Eng. Pat. 100,431, Jan. 5, 1916. (Appl. No. 192 of 1916.) Under Int. Conv., May 10, 1915. (See U.S. Pat. 1,150,113; this J., 1915, 968.)

THE alloys contain cobalt and chromium in such proportions as to render them resistant to corrosion by acids, etc., and iron (or nickel) sufficient to soften them without impairing their non-corrodibility. They are substantially free from carbon and other metals.—W. R. S.

Alloy. J. T. Dwyer, St. Louis, Mo. U.S. Pat. 1,203,991, Nov. 7, 1916. Date of appl., July 26, 1916.

THE alloy consists of lead 60—90 (preferably 88), antimony 10—40 (12), and phosphorus 0·001—0·05 (0·02) %.—W. R. S.

Furnaces for calcining copper ores and the like. J. G. Squire, Newcastle-on-Tyne. Eng. Pat. 101,998, Feb. 18, 1916. (Appl. No. 2424 of 1916.)

A MULTIPLE-HEARTH furnace of circular cross-section has concentric flues beneath the floor of each calcining chamber which produce concentric heat zones increasing or decreasing in intensity from the centre to the periphery of the hearths. A central rotating shaft carries four hollow rabble-arms on each floor to agitate the ore, and air is supplied through the rabble-arms and perforated rakes to aerate the ore. Circumferential flues are provided around the calcining chambers to heat the air supply; cold air is introduced if desired through the central shaft. The rakes on the rabble-arms are set at various angles. The supply

of hot and cold air to each hearth can be controlled independently by a two-way valve so as to maintain the desired temperature in each chamber. The central hollow shaft is adjustable to vary the distance of the rakes relatively to the hearths. —W. R. S.

Ore treatment; Agitator for ——. *Dehydrator.* C. Robinson, Mount Vernon, N.Y., Assignor to Metallurgical Engineering and Process Corporation. U.S. Pats. (A) 1,204,069 and (B) 1,204,070, Nov. 7, 1916. Dates of appl., (A) Oct. 1, 1910 (renewed Mar. 30, 1916); (B) Aug. 16, 1912.

(A) The lower part of a tank is divided into a series of trough-shaped compartments, and along the bottom of each trough is a transverse pipe with a series of holes through which jets of gas under pressure are forced. Above the pipe is a vertical, transversely elongated tube, and above the upper end of this tube is an inclined baffle-plate. The mixture of ore and solution in the troughs is carried upwards through the vertical tubes by the gas under pressure, and a portion of the mixture is deflected by the baffle-plates into the adjacent compartment. (B) An apparatus for washing and dehydrating ores comprises a tank containing a rotary, horizontal filtering-drum partially submerged in the washing-solution, an adjustable ore-feeding trough with a narrow longitudinal slot extending transversely across the upper surface of the drum, and a device for removing material from the surface of the drum after it emerges from the tank.—W. R. S.

Metals [zinc] from their ores; Process of extracting ——. S. E. Bretherton and F. L. Wilson, Berkeley, Cal. U.S. Pat. 1,204,843, Nov. 14, 1916. Date of appl., Dec. 23, 1912.

To extract zinc from zinc sulphide ores, the ore is pulverised, roasted to convert the zinc into basic sulphate, treated under pressure with a solution containing ammonia and carbon dioxide to dissolve the zinc, and the solution separated and heated to precipitate the zinc as a basic carbonate.—W. F. F.

Heat treatment [of metals]. W. J. Wrighton, Assignor to Leeds and Northrup Co., Philadelphia, Pa. U.S. Pat. 1,188,128, June 20, 1916. Date of appl., June 15, 1915.

See Eng. Pat. 100,679 of 1916; this J., 1916, 1161.

Ore-roasting furnace. J. Harris, Sheffield. U.S. Pat. 1,203,613, Nov. 7, 1916. Date of appl., July 30, 1914.

See Eng. Pat. 21,897 of 1913; this J., 1914, 1058.

Manufacture of zinc sulphate. Eng. Pat. 12,799. See VII.

XI.—ELECTRO-CHEMISTRY.

Hydro-electric power and chemical industry; Tasmanian ——. F. H. Campbell. Proc. Soc. Chem. Ind. of Victoria, 1916, 419—429.

The electric power scheme of the Tasmanian Government has been in operation since May last. The main water-storage basin is the Great Lake, The main water-storage basin is about 10,000 HP, but and the present output is about 10,000 HP, but this could be increased to 25,000 HP without extra storage; to 70,000 HP by increasing the water storage at the Great Lake and making use of the upper waters of the River Ouse; and to 150,000 HP by utilising Lakes Echo and St. Clair also as water-storage basins. The minimum charge for current (at Hobart) has been fixed at £2 per HP year for users of 10,000 HP and upwards of 24-hour power, i.e., about 0·073d. per unit; and a special discount is offered for a period of 12 months to those establishing new industries. The probable consumption of hydro-electric power in Tasmania in the near future, say within the next three years, is estimated as: public and domestic utilities in Hobart, 2500 HP, zinc ore reduction processes, 40,000 HP, manufacture of caustic soda and bleaching powder, 1500 HP, production of calcium carbide and possibly cyanamide, 4500 HP., manufacture of steel and ferro-alloy from scrap iron and steel in electric furnaces, 1000 HP, and for power and heating purposes in the manufacture of cement, 500 HP. Of the industries suggested, the electrolytic production of zinc is proposed by several companies. The electrical extraction of zinc has been attempted on three main lines:—(A) the partial roasting of the ores, with leaching, purification and electrolysis of the solution, the chief difficulty being the accumulation of impurities in the liquor; (B) electrolysis of fused zinc chloride, the chief difficulty being the production on a large scale of a salt free from oxychloride; (C) smelting with coal in an electric furnace, the objection to this being the large quantity of zinc dust produced. The method proposed, that of the Anaconda Copper Co., is to roast the ore, the residue being then leached with dilute sulphuric acid, freed from iron and manganese by limestone and the noble metals by zinc, the solution being finally electrolysed between insoluble lead anodes and zinc or aluminium cathodes. The deposited zinc is melted and cast into ingots. In the Gillies process, zinc sulphate is electrolysed between a rotating cylindrical zinc sheet as cathode, and lead anodes, with a woollen diaphragm for separating the gases. Other industries proposed are the electrolytic manufacture of aluminium, the production of nitric acid by the oxidation of ammonia or by the action of steam on cyanamide or by direct synthesis, the electrical smelting of iron, the preparation of per-salts, the use of chlorine prepared electrolytically for detinning scrap, and the manufacture of permanganate and aniline.—B. N.

Overvoltage tables. Part I. Cathodic overvoltages. Part II. Anodic overvoltages. E. Newbery. Chem. Soc. Trans., 1916, 109, 1051—1066 and 1066—1078.

The overvoltage (*i.e.*, the excess of back electromotive force over that of an oxygen or hydrogen electrode in the same electrolyte) has been determined for the following anodes and cathodes:—Gold, platinum, copper, silver, lead, zinc, nickel, cobalt, tin, gas carbon, artificial graphite, pure iron, carbon steel (5% carbon), chromium steel (10% chromium), and tantiron, in $N/1$ sulphuric acid and $N/1$ caustic soda, and, in addition, the cathodic overvoltages with aluminium, mercury, tungsten, antimony, bismuth, surfaces of copper and nickel plated with silver, and zinc and lead amalgamated with mercury. Pure electrolytic copper has generally a higher cathodic overvoltage than the commercial metal, and, if variation of the voltage leads to variation of the product (*e.g.*, in the reduction of nitrates), the greatest care must be taken in the preparation of the electrode in order to secure concordant results. Lead is capable of acquiring a very high cathodic overvoltage, but this is easily reduced, especially by impurities in the metal and subjection to too high a current density. The cathodic overvoltage of zinc is as great or greater than that of lead, and is increased by high current density; in acid and alkali it is increased with time. Zinc is preferable to lead as a cathode for powerful reductions when a fairly strong current is required, but against these advantages it is brittle and liable to be attacked by the electrolyte when no current is flowing. Nickel is a good substitute for platinum as a cathode where a low overvoltage is required, and in alkali the overvoltage is more constant than in acid. Mercury, as a cathode, has

the most variable overvoltage of all the electrodes tried; amalgamation raises the overvoltage of all metals. Tungsten is remarkable for the steadiness of its overvoltage, its small variations with time and current density, and the speed with which it attains its maximum. All the iron alloys have very low cathodic overvoltages in acid and alkali, and, with the exception of tantiron, are but slightly affected by time and current density changes. Perforated sheets of tantiron or gauze of chromium steel wire could probably be used with advantage in large scale work as cathodes for high-efficiency reductions in acid electrolytes. Whilst the overvoltage must be taken into account in electrolytic reductions and oxidations, yet the metal often exerts a specific effect on the reaction which may be of equal or greater importance than the overvoltage. This is especially the case with nickel, copper, or platinum, which sometimes effect reductions better than metals, such as zinc or lead, with greater cathodic overvoltages. If there is no such specific action, the electrode with the highest overvoltage may be depended on to give the best current efficiency when very powerful reductions are required. If the reduction proceeds easily with a cathode of low overvoltage, then a higher overvoltage results in waste of energy and the overheating of the solution, without any gain. Amongst the anodes, platinum most nearly approaches the ideal for all cases; its overvoltage is very constant, and high enough to effect powerful oxidations. Copper becomes passive in alkali, and has a low and constant overvoltage, but it cannot be used for long periods as it is slowly attacked. Silver may be used for oxidations in some cases in the presence of substances which reduce the silver oxide formed, and the disintegration is then considerably less than in pure electrolytes. Lead is a very suitable electrode for powerful oxidations in dilute acid, but in alkali it is liable to form plumbates. Pure nickel readily becomes passive in alkali, and the overvoltage is low and constant, but impurities cause it to become partially active; good quality nickel plating stands as well or even better than nickel sheet. In alkali, pure iron readily becomes passive, but tantiron, nickel steel, and chromium steel take this condition in acid much more readily than iron. Nickel steel (containing 36% nickel) has an anodic overvoltage intermediate between those of pure iron and nickel, and is very resistant to the anions in acid and alkali, whilst chromium steel is more liable to disintegration and oxidation. The overvoltage of tantiron is higher than that of pure iron, and both have considerably higher overvoltages in acid than in alkali. The anodic overvoltages, as a whole, are much higher than the cathodic, and none of the electrodes are capable of giving an anodic overvoltage of less than 0·4 volt for any length of time. Moderated oxidations are thus very difficult to obtain, and in the electrolytic treatment of organic compounds there is a tendency to give highly oxidised products, or even to destroy the substance, with formation of carbon dioxide. Gas carbon, at low current densities, is stated to be perhaps the most suitable anode in many cases for moderate oxidations, but even with this electrode the overvoltage is slowly increased. For small scale work, iridium anodes may sometimes be used in acid electrolytes, as this metal has a low and very constant anodic overvoltage (0·5 volt in $N/1$ sulphuric acid). For general work, the following appear to be the most suitable anodes: lead for dilute sulphuric acid or sulphate solutions, graphite for chloride solutions, pure nickel or high nickel steel for alkali solutions or fusions.—B. N.

Fuel cells; Galvanic —— at high temperatures. E. Baur, A. Petersen, and G. Füllemann. Z. Elektrochem., 1916, 22, 409—414.

THE electromotive force of the following voltaic cells at temperatures between 700° and 1300° C. was determined:—CuO, Cu_2O | Electrolyte | C; PbO, Pb | Electrolyte | C; Fe_3O_4, FeO | Electrolyte | CuO, Cu_2O; FeO, Fe | Electrolyte | CuO, Cu_2O; NiO, Ni | Electrolyte | CuO, Cu_2O; PbO, Pb | Electrolyte | CuO, Cu_2O. The electrolytes employed were borax, glass, and porcelain, and a detailed description of the construction of the cells is given.—G. F. M.

Potential changes on illumination of oxidising agents. Swensson. *See* VII.

PATENTS.

Electric furnace. W. J. Wrighton, Philadelphia, U.S.A. Eng. Pat. 100,093, Feb. 21, 1916. (Appl. No. 2584 of 1916.) Under Int. Conv., Feb. 19, 1915.

SEE U.S. Pat. 1,165,055 of 1915; this J., 1916, 261. A nickel-chromium alloy may be used as resistance-conductor, alundum cement as the non-vitreous refractory material, and a mixture of clay and asbestos fibre for the refractory backing layer.

Furnace; [Electric] induction ——. J. R. Wyatt, Assignor to The Ajax Metal Co., Inc., Philadelphia, Pa. U.S. Pat. 1,201,671, Oct. 17, 1916. Date of appl., Jan. 24, 1916.

THE furnace comprises a pool to contain molten metal, and a closed channel lying mainly or wholly beneath the pool. The channel is formed of substantially straight portions, communicating with one another at their lower ends at an acute angle, and at their upper ends with the body of the pool at opposite sides near its periphery. The channel is surrounded by a transformer, and current is induced through the molten metal in the channel as secondary; the "motor-effect," which is greatest at the acute angle, drives the molten metal up through the body of the pool on the outer sides of the channel, and a downward flow of molten metal takes place along the inner sides of the channel, stirring the metal in a general upward direction. The connecting portions between the channel and the pool are curved on the inner sides, the curved portion approximating in section to a circle through the axis of the transformer winding tangent to the straight channel portions.—B. N.

Furnace; Electric ——. I. Hechenbleikner, Charlotte, N.C., Assignor to Southern Electro-Chemical Co., New York. U.S. Pat. 1,202,837, Oct. 31, 1916. Date of appl., Feb. 7, 1914.

THE body portion of the furnace, in which the greater part of the reaction is adapted to take place, is cylindrical, and is provided with an expansible water-jacket formed with disconnected parts enclosing the sides and bottom in a continuous manner. Above the cylindrical part is an uncooled tapered masonry portion, in the form of a frustum of a cone, and provided with integral extensions on the sides, through which electrodes project downwards into the body portion. The electrodes are provided with water-jackets supported by, and extending partially into, the extensions. The tapering portion is continuous with a top cylindrical portion, formed with an integral conduit extending laterally. The body portion is provided with separated tap-holes, with two water-cooled jackets, in the form of a frustum of a cone telescoping one within the other, for each hole. The smaller end of the outer jacket is arranged to embrace the larger end of the other; a strap on the outer jacket projects over the inner one, and is adapted to hold the inner jacket in position.—B. N.

Furnace; Electric-arc ——. C. O. A. Dövle, Notodden, Norway, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,204,349, Nov. 7, 1916. Date of appl., Jan. 10, 1914.

THE vibrations of the U-shaped electrodes, due to the vibratory action set up by the movement of the arc along the electrodes, are prevented by water-cooled braces, each of which is attached to and projects through the walls of the furnace, some distance from the point where the electrode enters, and is also attached to a point on the electrode midway between the inner end of the electrode and the furnace wall.—B. N.

Battery; Galvanic ——. E. McGall, Orange, and M. D. Malcomson, Assignors to New Jersey Patent Co., West Orange, N.J. U.S. Pat. 1,201,481, Oct. 17, 1916. Date of appl., Aug. 12, 1914.

A COLLOIDAL gelatinous electrolyte is used containing one or more caustic alkalis, such as sodium hydroxide, and organic materials, together with another inorganic material, such as a silicate, for increasing the capacity and conductance.—B. N.

Ozone; Apparatus for producing ——. J. Steynis, Bay Shore, N.Y., Assignor to Steynis Ozone Co. U.S. Pat. 1,201,380, Oct. 17, 1916. Date of appl., Mar. 11, 1915.

SEE Fr. Pat. 478,133 of 1914; this J., 1910, 1163.

Electrolytic manufacture of light metals and reaction products thereof; Apparatus for the ——. E. A. Ashcroft, London. U.S. Pat. 1,204,234, Nov. 7, 1916. Date of appl., Mar. 12, 1912.

SEE Eng. Pat. 1003 of 1912; this J., 1913, 199.

Acid-proof and electrolytic tank. U.S. Pat. 1,202,457. *See* I.

Method and apparatus for heating liquids. Eng. Pat. 100,790. *See* I.

Electrolytic production of sodium perborate. Eng. Pat. 100,152. *See* VII.

XII.—FATS; OILS; WAXES.

PATENTS.

Oils; Separation of ——. S. Cornell, Pawling, N.Y. U.S. Pat. 1,202,969, Oct. 31, 1916. Date of appl., Jan. 22, 1916.

A MIXTURE of oils of mineral and animal or vegetable origin is emulsified by steam. The frothy emulsion rises and comes in contact with a heated surface, liberating the volatile hydrocarbon oil.—J. E. C.

Catalysts [for hydrogenating oils]; Process of revivifying ——. H. J. Morrison, Assignor to The Hydrogenation Co., Cincinnati, Ohio. U.S. Pat. 1,203,233, Oct. 31, 1916. Date of appl., June 12, 1914.

SPENT material containing a metallic catalyst is subjected to sufficient pressure to expel the bulk of the fat and to leave a coherent cake. The rest of the organic matter can then be removed by ignition, and the metal recovered in a catalytically active form.—C. A. M.

Cleansing compound for use in the bath or for like uses. J. Farley, Hertford. Eng. Pats. 15,643, Nov. 5, 1915, and 4634, Mar. 29, 1916.

COMMERCIAL methylated spirit or absolute alcohol (2 parts by weight or 14 to 20 fl. oz.) is mixed with pure saponified oil or fat, preferably vegetable (8 parts or 25 to 40 oz.), and pine oil (8 parts or 35 to 40 oz.), or paraffin oil (35 to 40 oz.), or a mixture of pine oil (2 parts) with paraffin oil (6 parts).—C. A. M.

Apparatus for purifying oil. U.S. Pat. 1,203,419. *See* IIA.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

PATENTS.

Lead carbonates (basic); Manufacture of ——. J. A. Schaeffer, Joplin, Mo., and J. R. MacGregor, Chicago, Ill., Assignors to Picher Lead Co., Joplin. U.S. Pat. 1,203,911, Nov. 7, 1916. Date of appl., May 2, 1916.

CARBON dioxide is passed into a mixture of "fumed litharge," acetic acid, and water until the basic lead carbonate formed has the desired composition.—E. H. T.

Printing composition [ink]. F. A. Putnam, Melrose, Mass. U.S. Pat. 1,203,779, Nov. 7, 1916. Date of appl., Dec. 20, 1912.

A GUM is digested in oil and the mixture incorporated with a metallic pigment and a non-metallic (aniline) colouring matter, these having contrasting colours, so that the one leaves a light imprint on dark substances and the other a dark imprint on light substances.—C. A. M.

Phenol-aldehyde resins soluble in oil; Method of manufacturing —— *and varnishes therefrom.* L. Berend, Amöneburg, Germany. U.S. Pat. 1,205,081, Nov. 14, 1916. Date of appl., June 1, 1915.

SEE Eng. Pat. 15,875 of 1914; this J., 1915, 805.

Resin sizing composition. U.S. Pat. 1,203,857. *See* V.

Dyeing leather, silk, cotton, wood, and paper, and preparation of water-, oil-, and lake-colours. Ger. Pat. 294,572. *See* VI.

Colour lakes fast to light. U.S. Pat. 1,203,642. *See* IV.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

PATENTS.

Vulcanisation [of rubber substitutes, etc.]. A. O. Bourn, Bristol, R.I. U.S. Pat. 1,203,966, Nov. 7, 1916. Date of appl., Jan. 7, 1916.

WOOD creosote is mixed with rubber substitutes and rubber compounds, with or without the addition of partially vulcanised oils or regenerated rubber, and the mixture is vulcanised.—C. A. M.

Vulcanising process [for rubber]. H. R. Murdock, Naugatuck, Conn., Assignor to Rubber Regenerating Co. U.S. Pat. 1,204,374, Nov. 7, 1916. Date of appl., May 4, 1916.

RUBBER is mixed with vulcanising material containing lead and sulphur, and a reagent (zinc sulphate) capable of transforming the lead and sulphur, during the vulcanising process, into light-coloured compounds insoluble in water, and the mixture is vulcanised.—C. A. M.

Non-inflammable waterproofing composition for fabrics. U.S. Pat. 1,204,056. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

PATENTS.

Imitation leather; Material adapted for use in the manufacture of —— *and method of making such material.* A. E. Alexander, London. From The Duratex Co., Newark, N.J., U.S.A. Eng. Pat. 102,114, May 22, 1916. (Appl. No. 7260 of 1916.)

SEE U.S. Pats. 1,190,806 and 1,190,807 of 1916; this J., 1916, 935.

Dyeing hairs, furs, etc. Ger. Pat. 294,184. *See* VI.

Dyeing leather, silk, cotton, wood, and paper, and preparation of water-, oil-, and lake-colours. Ger. Pat. 294,572. *See* VI.

XVI.—SOILS; FERTILISERS.

Sulphur in soils; Oxidation of —— as a means of increasing the availability of mineral phosphates. J. G. Lipman, H. C. McLean, and H. C. Lint. Soil Sci., 1916, **1**, 533—539. J. Chem. Soc., 1916, **110**, i., 784.

To study the effects of sulphur, weekly (later fortnightly) estimations of acidity and of soluble phosphoric acid were made in soils alone, in soils +sulphur, in soils+rock phosphate, and in soils+sulphur and rock phosphate. The soils employed were pure sea sand, a red silt loam, and a medium loam. The results show that considerable amounts of sulphuric acid are formed from the sulphur and that the acid acts on insoluble phosphates with production of phosphoric acid available to crops. The character of the soil plays an important part in stimulating or retarding oxidation of sulphur. The best results were obtained in the red silt loam which, at the end of fifteen weeks, contained nearly 2 grms. of citrate-soluble and nearly 1 grm. of water-soluble phosphoric acid, when 5 grms. of sulphur and 15 grms. of rock phosphate were added. In sand the amounts of soluble phosphoric acid produced were about one-fifth of the amounts in the red soil.

Salts; Antagonistic action of —— in plants. J. G. Maschhaupt. Verslag. Landbouwkund. onderzoek. Rijkslandbouwproefstat., 1916, **19**, 60 pp. J. Chem. Soc., 1916, **110**, i., 781.

In the author's experiments natural conditions were attained by growing the plants (maize) in earth contained in pots with perforated bottoms through which the roots passed into the prepared solutions below. Under these conditions solutions of the chlorides of sodium, potassium, and magnesium and magnesium sulphate, above certain concentrations, were strongly poisonous, calcium chloride to a much less extent. Even with concentrations of 3/25M the toxic action of sodium and potassium chlorides was annulled by the addition of only 10 c.c. of calcium chloride solution (3/25M) to 1138 c.c. of their solutions; the magnesium solutions required considerably more. The antagonism found by Osterhout between sodium and potassium chlorides, and between sodium chloride and magnesium sulphate was not confirmed with certainty, and in any case it is very small compared with that of calcium chloride. The calcium salts have a special function which can be undertaken by no other salt. The work of other investigators on this point, in particular that of Loew and Hansteen, is discussed. The contradictions there found may be explained on the ground that these authors drew their conclusions from quite different plant types, and it is not permissible to generalise on results obtained from one species, any more than to assume any parallelism in the antagonistic salt action in plants and animals. A feature common to all antagonistic action, however, is that it is a colloidal reaction, and the calcium ion undoubtedly has a special function in this respect, both in the animal and vegetable kingdoms. In practical agricultural investigations, when the plants are growing in the natural soil, great difficulties, underestimated by Loew and his collaborators, are experienced, particularly since sufficient knowledge is lacking of the way in which the roots exert their functions.

General conceptions of intoxication [of enzymes]. Jacoby. *See* XVIII.

Determination of nitric nitrogen. Scales. *See* XXIII.

PATENT.

Phosphate rock; Treatment of ——. E. S. Bishop, Pittsburgh, Pa., Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pat. 1,204,238, Nov. 7, 1916. Date of appl., Aug. 10, 1914. Renewed Feb. 1, 1916.

PHOSPHATIC rock is made available for plant food by mixing it with the chloride of a strong base, *e.g.*, of an alkali metal, and sufficient silica to combine with the metal of the chloride and with some of the calcium of the rock, and then heating in steam to a temperature below that at which sintering takes place, the hydrogen chloride evolved being recovered.—E. H. T.

XVIII.—FERMENTATION INDUSTRIES.

Prohibition of use of wheat in manufacture of beer, etc.

IT has been reported to the Board of Trade that, in consequence of the scarcity and the high price of barley, purchases of wheat have recently been made by brewers for use in their business. The Board of Trade have accordingly made an Order, the effect of which is to prohibit the use of wheat in the manufacture of beer and similar liquors. The Order came into force on 27th November. The use of any grain for the production of spirits, without the authorisation of the Ministry of Munitions, was prohibited by an Order dated 10th May last.

Formaldehyde as a prototype of diastase. Theory of diastatic action. G. Woker. Ber., 1916, **49**, 2311—2318.

PROCEEDING from the supposition that diastase and peroxidase are identical substances, the theory is developed that the actions of diastase and peroxidase are attributable to the same group in the molecule, viz., an aldehyde group which can form on the one hand an unstable aldehyde hydrate with water, giving rise to the hydrolytic reaction, and on the other hand a secondary peroxide structure, of the type ·CH(OH)·O·OH, with hydrogen peroxide. The author has already shown that formaldehyde may be regarded as typical of peroxidase and catalase (Ber., 1914, **47**, 1024), and it was therefore expected, from the above theory, that it should also be a prototype of diastase. The point whether formaldehyde and diastase behave analogously when tested by the usual method of diastase determination, was therefore investigated both from the point of view of the disappearance of starch, and of the formation of sugars or dextrins, and a general parallelism was found, though not so close as that between peroxidase and formaldehyde. Notably it was observed that an increase instead of a decrease of viscosity occurred during the action of formaldehyde on starch, and that a relatively high concentration of aldehyde was necessary before any sugar formation occurred. Nevertheless starch hydrolysis was undoubtedly produced, since the blue iodine reaction disappeared, and an osazone was actually isolated from the product.—G. F. M.

Oxidase reactions; Relation of —— to hydrogen ion concentration. G. B. Reed. J. Biol. Chem., 1916, **27**, 299—302.

THE concentrations of acid which inhibit oxidases are much lower than stated by previous investigators, who have not usually taken into account the effect of protein or other amphoteric electrolytes in reducing the acidity when definite amounts of acid have been added to the oxidase mixture. Certain oxidases, such as those of the potato and apple, are inhibited by hydrogen ion concentrations as low as 5 to 7×10^{-4}. The activation of certain oxidase reactions by the addition of exceedingly

small amounts of alkali may thus be due to the reduction of the hydrogen-ion concentration. —T. C.

Intoxication [*of enzymes*]; *General conceptions of* ——. M. Jacoby. Biochem. Zeits., 1916, **76**, 275—296. J. Chem. Soc., 1916, **110**, i., 778–779.

Urease is rendered inactive by minute amounts of mercuric chloride to which, whatever the quantity, no accelerative action can be ascribed. The enzyme inactivated by the mercury salt can be reactivated by potassium cyanide. A relatively large amount of this salt is necessary to diminish the activity of the urease, but medium quantities cause a distinct, though not very large increase in its activity. An aqueous solution of the enzyme is inactivated by nickel oxide (insoluble in water); after separation from the nickel oxide it can be reactivated by potassium cyanide. Urease rendered inactive by mercuric chloride cannot be reactivated by glycine, whereas if rendered inactive by nickel oxide it can be reactivated by small quantities of this substance. The scission of urea by bacteria is inhibited both by mercuric chloride and potassium cyanide, neither substance exerting a stimulating action in very small concentrations. Bacteria of which the ureaclastic activity has been destroyed by the mercury salt, are not rendered reactive in this respect by potassium cyanide. The doses of nickel oxide, mercuric chloride, and potassium cyanide which stop the ureaclastic action do not kill the bacteria. Bacteria which act on urea do not act on methylurea, thiourea, or acetamide. The author distinguishes between two types of toxic action; substances exerting the one type of action kill the ferment, whereas those belonging to the other only inhibit the fermentative action.

Patent.

Alcohol-free beers; Process of making practically ——. C. Reiter, Bayrischzell-Hochkreut, Germany. U.S. Pat. 1,204,315, Nov. 7, 1916. Date of appl., Apr. 6, 1914.

See Eng. Pat. 23,003 of 1913; this J., 1915, 846.

XIXa.—FOODS.

Cocoa powder; Detection of excess of cacao shell in ——. Chem.-Zeit., 1916, 40, 969—970.

The following official (German) directions are given for the detection of cacao shell in cocoa powder. A preliminary microscopical examination will show whether the powder contains an undue proportion of shell, and if such is the case the crude fibre content of the sample is determined; if, owing to the fineness of the powder, the microscopical examination is inconclusive, the insoluble phosphates present must be determined in addition to the crude fibre. Since the results obtained are expressed as percentages of the dry fat-free powder, the moisture and fat are also determined. *Moisture.* Five grms. of the cocoa powder is mixed in a flat basin with 20 grms. of ignited sand and dried at 105° C. to constant weight, or nearly so, but the drying should not be prolonged for more than 4 hours. *Fat.* Five grms. of the cocoa is placed in an asbestos filter tube, 4 cm. in diameter (the asbestos is supported on a small filter plate having holes about 1 mm. in diameter), the lower end of the tube is inserted into a hole in a rubber stopper closing a filter flask, and the filter tube is filled with ether. As soon as the ether begins to drop into the flask, suction is applied, a further quantity of ether is added, and so on, using about 10 c.c. of ether each time, until 100 c.c. of ethereal extract has been collected. This ethereal solution is evaporated, and the residue of fat weighed. *Crude fibre.* The residue remaining in the filter tube is freed from ether and, together with the asbestos, is transferred to a flask and boiled for 1 hour under a reflux condenser with 200 c.c. of 1·25% sulphuric acid. The mass is then collected on an asbestos filter, washed with hot water, again transferred, with the asbestos, to the flask, boiled for 1 hour with 200 c.c. of 1·25% potassium hydroxide solution, then collected on an asbestos filter, and washed. This treatment with acid and alkali is repeated. The mass of crude fibre obtained finally is washed with alcohol and ether, transferred to a platinum basin, dried at 105° C., and weighed. The contents of the basin are then ignited, and the residue again weighed; the difference between the weights gives the quantity of crude fibre. The asbestos used for the filters should be treated previously with boiling dilute sulphuric acid, then with dilute potassium hydroxide solution, washed, dried, and ignited. If the amount of crude fibre found exceeds 6%, calculated on the dry, fat-free cocoa powder, the sample contains a quantity of shell in excess of that which should be present. *Phosphates.* Twenty grms. of the cocoa is incinerated at a low temperature, the carbonised mass is collected on a filter, washed with water, and the filter and its contents are ignited to a white ash to which the filtrate is added and evaporated to dryness. After gentle ignition, the residue is treated with a few drops of hydrogen peroxide and 10 c.c. of 25% hydrochloric acid, the mixture is evaporated to dryness, the residue treated with hydrochloric acid and hot water, and the solution filtered. The filtrate is nearly neutralised with sodium hydroxide solution, using methyl orange as indicator, then heated on a water-bath for 5 mins., a further small quantity of alkali is added so that the solution still remains slightly acid, and the precipitated iron and aluminium phosphates are collected on a filter; the filtrate and washings are diluted to 100 c.c. To determine the soluble phosphates, 10 c.c. of this solution is mixed with 30 c.c. of neutral 40% calcium chloride solution, a few drops of phenolphthalein solution are added, and the mixture is titrated with $N/10$ sodium hydroxide solution until a distinct red coloration is obtained; the mixture is now maintained at 15° C. for two hours and the slight excess of alkali is titrated. Under these conditions, 1 c.c. of $N/10$ alkali solution is equivalent to 4·75 mgrms. of PO_4. The insoluble phosphates are determined as follows:—30 c.c. of trisodium citrate solution (200 grms. of the salt dissolved in 300 c.c. of water) is placed in a flask, cooled in ice-water, and then exactly neutralised, using phenolphthalein as indicator. The filter containing the precipitate of iron and aluminium phosphates is introduced into the flask, the mixture is heated on a water-bath for 20 mins., then cooled in ice-water, and titrated with $N/10$ sodium hydroxide solution; in this case, 1 c.c. of the alkali solution is equivalent to 9·5 mgrms. of PO_4. The results of both determinations are calculated into percentages of the cocoa powder. With a cocoa powder free from excess of shell, the quantity of insoluble PO_4 will not exceed 4% of the total PO_4.—W. P. S.

Vegetable ivory meal; Composition, digestibility, and feeding value of ——. C. L. Beals and J. B. Lindsay. J. Agric. Res., 1916, 7, 301—320.

Vegetable ivory nuts (*Phytelephas macrocarpa* seeds) have the following average composition:—moisture, 11·39; ash, 1·08; protein, 4·63; fat, 0·92; crude fibre, 6·89; non-nitrogenous substances, 75·09%. Large quantities of the nuts are imported and used principally for making buttons, and the waste material (sawdust, chippings, and turnings) of this manufacture is ground to a meal which may be used for feeding cattle. The meal is tasteless, odourless, and very hard, being almost gritty to the touch. About 92·5%

of the non-nitrogenous substances consists of mannan, a polymer of mannose (cf. J. L. Baker and T. H. Pope; this J., 1900, 550), and the energy equivalent of the meal compares favourably with that of other carbohydrate foods. Sheep eat vegetable-ivory meal readily when it is mixed with other grains, and it is digested thoroughly; about 84% of the dry substance and 92% of the non-nitrogenous substances is digested by these animals. Cows will eat the meal when it is mixed with other foods, but refuse to eat it by itself; its use increases the quantity of milk yielded by cows, but its value is not quite equal to that of maize meal in this respect.—W. P. S.

Physiological and pharmacological studies on coal-tar colours. Fat-soluble dyes. Salant and Bengis. *See* IV.

Relation of oxidase reactions to hydrogen ion concentration. Reed. *See* XVIII.

Determination of nitric nitrogen. Scales. *See* XXIII.

PATENTS.

Colour concentrate for edible fats. C. Ellis, Montclair, N.J. U.S. Pat. 1,203,594, Nov. 7, 1916. Date of appl., Dec. 16, 1915.

A BUTTER colouring composition consists of the liquid portion of butter fat saturated with a yellow dye and sterilised.—W. P. S.

Egg product; Powdered —— and process for making the same. G. C. Contant, New York, Assignor to J. Decker, jun., Montclair, N.J. U.S. Pat. 1,203,983, Nov. 7, 1916. Date of appl., Jan. 22, 1916.

WHITES of eggs are separated from the yolks, stirred until of uniform consistence, sugar is then added, the mixture dried at a temperature below 212° F. (100° C.), and powdered.—W. P. S.

XIXB.—WATER PURIFICATION; SANITATION.

Determination of nitric nitrogen. Scales. *See* XXIII.

PATENTS.

Still [for water]; Triple purification ——. D. P. Moore, Assignor to J. S. Merrill and G. H. Draper, Washington, D.C. U.S. Pat. 1,204,300, Nov. 7, 1916. Date of appl., Feb. 17, 1916.

A WATER still comprises an evaporator, a distilled water reservoir, and a condenser arranged one above the other. Vapour tubes extend from the evaporator, through the reservoir, to the condenser and project into the lower ends of the condenser tubes. An air heater is provided in the evaporator, and a number of tubes conduct the heated air into the vapour tubes, so that the vapour and heated air mix in the vapour tubes and condenser tubes.—W. P. S.

Drying and sterilising air; Process for ——. R. P. van Calcar, Oegstgeest, and J. Ellerman and H. J. Martijn, The Hague, Netherlands. U.S. Pat. 1,203,941, Nov. 7, 1916. Date of appl., Dec. 29, 1911.

THE process is essentially the same as that described in Eng. Pat. 24,159 of 1913 (this J., 1915, 245), but distinct layers of a soluble drying substance and an anti-hardening material are used.—A. S.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Cinchona alkaloids; Degradation of the ——. A. Kaufmann, E. Rothlin, and P. Brunnschweiler. Ber., 1916, **49**, 2299—2310.

THE possibility of the synthesis of quinine from meroquinene or cincholoipone, the common degradation products of all the cinchona alkaloids, renders the preparation of one or other of these substances in satisfactory yield a matter of technical interest. The three following methods were accordingly worked out for the preparation of cincholoipone from cinchotin (dihydrocinchonine):—(1) By boiling with sodium acetate and 50% acetic acid, cinchotin was isomerised to the "toxin" cinchoticin, which was isolated as its benzoyl derivative in white needles, m.pt. 124° C., in 95—100% yield. This on oxidation with chromic acid gave cinchoninic acid and benzoylcincholoipone, but the yield amounted to only 10% of the theory. (2) Benzoylcinchoticin gave with dimethyl sulphate an addition product which on oxidation with permanganate gave formylmethylanthranilic acid and benzoylhomocincholoipone, a reddish-yellow oil which on hydrolysis was converted into homocincholoipone hydrochloride. (3) The best results were obtained by the action of an acid chloride on the isonitroso-derivative of benzoylcinchoticin. This was obtained in nearly theoretical yield by the action of amyl nitrite on the sodium derivative of the ketone in alcoholic solution, and was isolated as white needles, m.pt. 175°—177° C. On shaking its alkaline solution with *p*-toluene sulphochloride, quantitative decomposition into cinchoninic acid and benzoylcincholoipone nitrite occurs. The latter distilled at 160°—165° C. *in vacuo*, and gave cincholoipone on hydrolysis with barium hydroxide or 70% sulphuric acid.—G. F. M.

Alkaloidal chemistry; Mercuric acetate as an oxidising agent in ——. J. Gadamer, F. Kuntze, R. Kondo, and Schulemann. Arch. Pharm., 1915, **253**, 274—289. J. Chem. Soc., 1916, **110**, i., 736—737.

THE author finds that in alkaloidal chemistry mercuric acetate has not only a qualitative, but also a quantitative value, since the resulting sparingly soluble mercurous acetate can be collected and weighed. N-Methylbulbocapnine yields a di-dehydro-derivative when oxidised in dilute acetic acid by mercuric acetate at the ordinary temperature:

$$C_{20}H_{21}O_4N + 2Hg(C_2H_3O_2)_2 = C_{20}H_{19}O_4N + 2CH_3COOH + Hg_2(C_2H_3O_2)_2.$$

A deeper-seated oxidation also proceeds to some extent, and this becomes more marked when the oxidation is effected on the water-bath, the amount of mercurous acetate obtained indicating a consumption of 3 mols. of mercuric acetate. By oxidation in a similar manner at the ordinary temperature, *d*-canadine is converted into berberine, and corydaline also loses four atoms of hydrogen. In the latter case the oxidation proceeds in two stages, a di- and a tetra-dehydrocorydaline being obtained. Since the optical activity of the alkaloid disappears with the first pair of hydrogen atoms, the two asymmetric carbon atoms in corydaline would appear to be contiguous. The oxidation of *r*-laudanosine by mercuric acetate yields the same products as Pyman obtained with manganese dioxide and dilute sulphuric acid (Chem. Soc. Trans., 1909, **95**, 1266; see also Eng. Pat. 314 of 1909; this J., 1909, 913), namely, veratraldehyde and 4.5-dimethoxy-2-β-methylaminoethyl-benzaldehyde. The non-nitrogenous substance, $C_{14}H_8(OCH_3)_4$, mentioned by Pyman, is produced in considerable quantity, and appears to be tetramethoxydibenzyl, $C_{14}H_{10}(OCH_3)_4$. The oxidation of papaverine by mercuric acetate yields papaveraldine, dimethoxycinchonic acid, and about 10% of papaverinol, which thus becomes a comparatively easily obtainable substance. When papaverine and mercuric acetate are mixed in equivalent quantities a clear solution is obtained, from which a white precipitate containing non-

ionisable mercury is thrown down by sodium chloride. The clear solution therefore probably contains a mercuriacetate, this group having entered at the methylene bridge. The substance is not very stable, however, and reacts with a further quantity of mercuric acetate to form mercurous acetate, acetic acid, and papaverinol.

Apomorphine; Sensitive reaction for ——. L. P. J Palet. Ann. Soc. Quim. Argentina, 1916, 4, 83—86. J. Chem. Soc., 1916, 110, ii., 587.

WITH Guglialmelli's arseno-tungstic or arseno-tungsto-molybdic reagent, apomorphine gives an indigo-blue coloration; the coloured substance dissolves in amyl alcohol to a solution of the same colour, and in benzene to an intense violet solution. (See also following abstract.)

Dimethylaminophenyldimethylisopyrazolone (pyramidone); Delicate test for ——. L. Guglialmelli. Annal. Soc. Quim. Argentina, 1916, 4, 180—182. J. Chem. Soc., 1916, 110, ii., 587—588.

ARSENOTUNGSTIC acid gives with dimethylamino-phenyldimethylisopyrazolone a white precipitate soluble in alkali with production of an intense blue coloration. Arsenotungstomolybdic acid gives a white precipitate, soluble in alkali to an indigo-blue solution. Both nitric acid and ferric chloride give an indigo-blue coloration.

Medicines; Preservation of —— in dry capsules, especially for use in the field. T. Paul. Münch. Med. Wochenschr., 1916, 1317—1321. Chem.-Zeit., 1916, 40, Rep., 364—365.

COMPARATIVE tests at 37°, 70°, and 100° C., with containers of ordinary medicine glass, Jena glass, and quartz showed that decomposition of morphine hydrochloride in aqueous solution takes place slowly even in quartz and hence cannot be due to impurities dissolved from glass, though such impurities markedly accelerate the decomposition. Salts of physostigmine, atropine, scopolamine, homatropine, and hydrastine, and suprarenin (adrenaline) and organotherapeutic preparations decompose still more readily and it is very difficult to sterilise their aqueous solutions. Addition of very small quantities of hydrochloric acid or of glycerin, alcohol, dextrose, etc., has been proposed as a remedy, but is ineffective, and, in some cases, may even accelerate the decomposition, without this becoming apparent to the eye. The author recommends that measured quantities of the solid medicine and of the solvent should be put up in separate containers and mixed immediately before use. The dry medicine is dissolved in a volatile solvent and introduced into a dry, sterilised, boat-shaped capsule, drawn out at the ends; the solvent is then expelled by a current of germ-free air at 20°—30° C., and the ends of the capsule sealed. The solvent (dilute sodium chloride solution or distilled water) is introduced into a pipette-shaped container, which is then sealed and sterilised.—A.S.

Fatty acids; Oxidation of branched chain ——. Action of hydrogen peroxide on the homologues of isobutyric acid. P. A. Levene and C. H. Allen. J. Biol. Chem., 1916, 27, 433—462.

THE action of hydrogen peroxide on the higher homologues of dimethylacetic (isobutyric) acid was investigated with the object of establishing the conditions under which the tertiary carbon atom was oxidised readily. In the course of the work the acids, esters, alcohols, iodides, and substituted malonic acids of eight homologues of isopropane were prepared, whilst the oxidation experiments were made on acids ranging from 2-methylpropylic acid to 9-methyldecylic acid. The following products of oxidation were to be expected:—
$(CH_3)_2CH(CH_2)_nCH_2CH_2COOH \rightarrow$
$(CH_3)_2CH(CH_2)_nCH_2CHO$, or
$(CH_3)_2CH(CH_2)_nCOCH_3$, or $(CH_3)_2CO$. The latter reaction proceeded most favourably when the organic acid in slightly acid solution was treated with an amount of hydrogen peroxide equivalent to 3·5 atoms of oxygen. Under these conditions, all three reactions took place, but acetone was the predominating product of the oxidation. The presence of the higher ketones was demonstrated by an indirect method; the value of the mixed ketones was determined and from this was deducted the value of the acetone, identified previously by means of its p-nitrophenylhydrazone. The aldehydes resulting from the oxidation in the α-position were identified as the corresponding acids. There was a progressive decrease in the yield of acetone as the distance between the tertiary carbon atom and the carboxyl group increased, but a marked exception to this rule was observed with isobutyric and isovaleric acids.—W. P. S.

Silver in protein preparations; Determination of ——. H. Wastenson. Pharm. Post, 1916, 49, 187—188. J. Chem. Soc., 1916, 110, ii., 577.

A METHOD is described for the estimation of silver in protein preparations (for example, *Argentum proteinicum*) which also contain chlorides. From 0·2 to 0·5 grm. of the substance is heated with 10 c.c. of concentrated sulphuric acid and 2 c.c. of concentrated nitric acid until nitrous fumes cease to appear; after cooling, the mixture is diluted with 25 c.c. of water, heated until the water has evaporated, and the heating then continued for a further thirty minutes. The clear solution is now diluted with water to about 100 c.c. and titrated with N/10-ammonium thiocyanate solution in the presence of ferric alum.

Physiological and pharmacological studies on coal-tar colours. Fat-soluble dyes. Salant and Bengis. *See* IV.

Volumetric determination of mercury salts. Evaluation of mercuric chloride compresses. Adanti. *See* VII.

General conceptions of intoxication [of enzymes]. Jacoby. *See* XVIII.

PATENTS.

(A) *Cephaeline isobutyl ether, and* (B) *cephaeline propyl ether, and salts thereof.* J. W. Meader, Indianapolis, U.S.A. Eng. Pats. (A) 11,717, (B) 11,719, Aug. 13, 1915.

(A) CEPHAELINE isobutyl ether is produced by treating cephaeline with an alkali metal and an isobutyl halide. *Example*:—17 grms. of isobutyl bromide is added to 46·6 grms. of cephaeline and 4·6 grms. of sodium dissolved in about 400 c.c. of absolute alcohol, and the mixture is boiled for about 2 hours. The alcohol is then distilled off, the residue dissolved in dilute hydrochloric acid, made alkaline with ammonia, and extracted with ether. The ethereal solution is extracted with excess of dilute caustic soda, to remove unchanged cephaeline, and is evaporated to dryness. The product may be purified by dissolving it in an acid, crystallising the salt, dissolving it in water, adding ammonia, extracting with ether, evaporating off the ether, and drying *in vacuo*. Cephaeline isobutyl ether is a varnish-like substance, easily soluble in alcohol, ether, and chloroform. It forms a crystalline hydrobromide (white needles) and hydrochloride. (B) Cephaeline propyl ether, having similar properties to the isobutyl ether, is prepared by a similar reaction, using 16 grms. of propyl bromide instead of 17 grms. of isobutyl bromide. —F. Sp.

Carbon tetrachloride; Process of making ——. C. J. Strosacker, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pat. 1,204,608, Nov. 14, 1916. Date of appl., Feb. 13, 1915.

CARBON tetrachloride is prepared by treating

sulphur dichloride with carbon bisulphide until the sulphur dichloride is reduced practically to sulphur monochloride, and then raising the temperature and adding more carbon bisulphide until the sulphur monochloride is reduced to sulphur. The process may be modified by carrying on the first stage until the residue consists of a hot solution of sulphur in sulphur monochloride, adding more sulphur dichloride, and continuing the addition of carbon bisulphide until the same point is reached again, and finally raising the temperature and adding carbon bisulphide until the residue, which is kept liquid, consists mainly of sulphur. The carbon tetrachloride evolved in the reactions is condensed.—F. SP.

2-*Naphthylquinoline-4-carboxylic acids.* M. Dohrn, Assignor to Chem. Fabr. auf Actien (vorm. E. Schering), Berlin. U.S. Pat. 1,197,462, Sept. 5, 1916. Date of appl., June 10, 1915.

2-NAPHTHYLQUINOLINE-4-CARBOXYLIC acids are prepared by condensing isatin with acetonaphthone (methyl naphthyl ketone) in alkaline solution or by condensing aniline with pyroracemic acid (pyruvic acid) and naphthaldehyde. *Example:* 180 parts of isatin dissolved in 500 parts of alcohol, 300 parts of 33% caustic potash solution, and 90 parts of methyl α-naphthyl ketone, are heated together on the water-bath for some hours. The alcohol is then distilled off, and the product precipitated by hydrochloric acid, dissolved in sodium carbonate solution, re-precipitated, and crystallised from dilute alcohol. 2.1′-Naphthylquinoline-4-carboxylic acid forms yellowish-red needles, melting at 198° C.; 2.2′-naphthylquinoline-4-carboxylic acid forms yellow crystals, melting at 234° C. Both compounds are soluble in alcohol and alkalis and insoluble in benzene, and are remedies for gout and rheumatism.—F. SP.

Surgical suture and ligature and method of preparing same. C. H. Watson, Assignor to Davis & Geck, Inc., Brooklyn, N.Y. U.S. Pat. 1,202,931, Oct. 31, 1916. Date of appl. Oct. 29, 1915.

CATGUT sutures for surgical purposes are impregnated with a solution of potassium mercuric iodide.—F. SP.

Chloroform; Process for purifying ——. G. Michaelis, Albany, N.Y. U.S. Pat. 1,203,032, Oct. 31, 1916. Date of appl., July 12, 1916.

100 PARTS of chloroform is shaken with 33 parts of sulphuric acid of 66° B. (sp.gr. 1·33) until a sample of the chloroform, after separation of the discoloured acid, no longer colours pure sulphuric acid when shaken with it for at least five minutes. The acid is then separated and a fresh quantity of 33 parts of sulphuric acid of the same strength is added, and the mixture is shaken and heated nearly to the boiling point of chloroform. Any chloroform which distils off is condensed and returned to the mixture, which is cooled and allowed to settle. The chloroform layer is drawn off, freed from acid by treatment with a suitable alkali, dried, and distilled. The first portion (10 parts) of the distillate is slightly impure. The next portion (60 or 70 parts) is pure chloroform, which is preserved by the addition of 0·6% to 1% of alcohol.—F. SP.

Combination of organic acids [viz., salicylic acid and 2-phenylquinoline-4-carboxylic acid]. A. B. Davis, Assignor to Eli Lilly and Co. Indianapolis, Ind. U.S. Pat. 1,203,499, Oct. 31, 1916. Date of appl., July 26, 1915.

A COMPOUND of salicylic acid and 2-phenylquinoline-4-carboxylic acid is produced by precipitating an equimolecular mixture of their alkali salts with a mineral acid.—F. SP.

Combination of organic acids. [Ester of 2-phenylquinoline-4-carboxylic acid and salicylic acid.] A. B. Davis, Assignor to Eli Lilly and Co., Indianapolis, Ind. U.S. Pat. 1,203,500, Oct. 31, 1916. Date of appl., July 26, 1915.

AN ester of salicylic acid and 2-phenylquinoline 4-carboxylic acid is produced by treating 2-phenyl quinoline-4-carboxylic acid with thionyl chloride and combining the resulting chloride with salicylic acid. It has the formula, $C_9H_5N(C_6H_5)(CO{\cdot}O\,C_6H_4{\cdot}COOH)(2.4)$.—F. SP.

Combination of organic acids [2-phenylquinoline 4-carboxylic acid and salicylic acid]. A. B Davis, Indianapolis, Ind., U.S.A. Eng. Pat 102,136, Aug. 29, 1916. (Appl. No. 12,220 o 1916.)

SEE U.S. Pat. 1,203,499 of 1916; preceding.

Therapeutically-active substance [from bile]. R. C. W. Nöhring, Koswig, Germany. U.S. Pat. 1,204,479, Nov. 14, 1916. Date of appl., May 22, 1914.

SEE Ger. Pat. 280,108 of 1913; this J., 1915, 452.

Phosphorus and oxygen containing organic compounds. R. Willstätter, Berlin. U.S. Pat. 1,205,138, Nov. 14, 1916. Date of appl., Apr. 16, 1915.

SEE Ger. Pat. 288,393 of 1914; this J., 1916, 385.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Tone reproduction and its limitations. F. F Renwick. Traill-Taylor Memorial Lecture. Phot. J., 1916, 56, 222—238.

THE possibility of obtaining a correct continuous tone reproduction, *i.e.*, one in which the tone values bear the same relationship as in the original, is dependent upon the luminosity range of the object, the qualities of the plate used for taking the negative, and the quality of the printing medium. The total range of most subjects is less than 30 to 1 and this range is easily obtained on the "correct exposure" portion of a good negative plate. The total range of photographic papers, including the "under-" and "over-exposure" periods, varies from about 16 to 1 with matt surface development papers, up to 50 to 1 with glossy development papers, and reaches as high as 200 to 1 with glossy P.O.P. The curves of a number of papers, obtained by plotting logarithms of exposures against reflection-densities, are given. A special instrument was designed for measuring reflection densities, the paper surface being illuminated at 45° and viewed at 90° to avoid the interference of specular reflection. Curves are given illustrating the results obtained by reproducing through a given plate on to a given paper. It is easily seen that scientifically correct reproduction is not obtainable except for a very limited range and using only the middle tones of both plate and paper. The problem as to whether scientifically correct reproduction is also artistically correct is then considered. Numerous facts are collated dealing with the sensitiveness of the eye under different conditions to lights of varying luminosity. The normal eye sees correctly over a range of about 20 to 1 in bright diffused daylight and approximately correctly over a range of about 100 to 1. Outside these limits—from 10,000 to 1,000,000 foot-candles luminosity—departures from correct seeing are increasingly greater, a given range of luminosities appearing less than it is. The exact relationship which should exist therefore between the range of luminosities in the original and the range of tones in the reproduction is dependent upon the actual values of the former and also to some extent on the conditions under which the reproduction is to be viewed. The